

## 11.0 Readers' Guide and Summary of Effects

### 11.0.1 Readers' Guide

Chapter 11, *Fish and Aquatic Resources* describes the environmental setting and potential impacts of the BDCP on covered and non-covered fish and aquatic species in and upstream of the Sacramento-San Joaquin Delta. The chapter provides the results of the evaluation of the effects of implementing 16 of the BDCP conservation measures on 20 fish and aquatic species under a no action alternative and 15 different project alternatives. This guide is intended to help the reader understand the organization of the chapter and more easily identify the existing conditions information and impact analysis of species of interest.

#### 11.0.1.1 Species Evaluated in Chapter 11

The chapter analyzes 20 fish and aquatic species – 11 of which are covered species and 9 of which are non-covered species.

Covered fish species are those identified as endangered, threatened, or at risk of being listed as endangered or threatened during the BDCP permit term, for which BDCP will provide conservation and management. The covered fish species analyzed in Chapter 11 are:

- Delta smelt
- Longfin smelt
- Winter-run Chinook salmon
- Spring-run Chinook salmon
- Fall-run/Late fall-run Chinook salmon
- Steelhead
- Sacramento splittail
- Green sturgeon
- White sturgeon
- Pacific lamprey
- River lamprey

The non-covered fish and aquatic species are identified by state or federal agencies as special status or of particular ecological, recreational, or commercial importance. The non-covered fish and aquatic species analyzed in Chapter 11 are:

- Striped bass
- American shad

- 1       • Largemouth bass
- 2       • Sacramento–San Joaquin roach
- 3       • Hardhead
- 4       • Sacramento perch
- 5       • Sacramento tule perch
- 6       • Threadfin shad
- 7       • California bay shrimp

### 8   **11.0.1.2     Relationship of Chapter 11 to the BDCP Effects Analysis**

9       Chapter 5 of the BDCP is the Effects Analysis. The Effects Analysis describes how the BDCP will affect  
 10       ecosystems, natural communities, and covered species, including the covered fish species analyzed  
 11       in Chapter 11. The Effects Analysis presents conclusions regarding expected outcomes from  
 12       implementing the BDCP conservation strategy and covered activities. The effects analysis was  
 13       compiled using an extensive amount of monitoring data, scientific investigation, and analysis of the  
 14       Delta. The appendices to the Effects Analysis contain a full technical description of all of the methods  
 15       and results.

16       The methods used to analyze impacts to covered and non-covered fish and aquatic species in  
 17       Chapter 11 rely on the models and data included in the Effects Analysis. Chapter 11 references  
 18       specific sections of the Effects Analysis, including Appendix 5.B, *Entrainment*; Appendix 5.C, *Flow,*  
 19       *Passage, Salinity, and Turbidity*; Appendix 5.D, *Contaminants*; Appendix 5.E, *Habitat Restoration*; and  
 20       Appendix 5.F, *Biological Stressors on Covered Fish*. Readers are directed to specific sections of the  
 21       Effects Analysis that are referenced in Chapter 11. An understanding of the Effects Analysis will help  
 22       inform a review of Chapter 11. In some instances the description of fish species life stage timing and  
 23       distribution varies between the Effects Analysis and EIR/EIS. These differences are in the process of  
 24       being updated to match one another, consistent with the agency input received during development  
 25       of the analyses. These updates are not anticipated to result in changes to conclusions in either  
 26       document.

### 27   **11.0.1.3     NEPA and CEQA Conclusions**

28       The analysis in Chapter 11 has been prepared in accordance with NEPA and CEQA. In some  
 29       instances, the NEPA and CEQA conclusions differ for a particular impact discussion because NEPA  
 30       and CEQA have different points of comparison (or “baselines” in CEQA terms). The NEPA point of  
 31       comparison for each alternative is based on the comparison of the late long-term action alternative  
 32       (Alternatives 1A through 9) with the late long-term no action alternative. The CEQA baseline is  
 33       based on the comparison of the late long-term action alternative (Alternatives 1A through 9) with  
 34       EBC1 (Existing Conditions, defined not to include Fall X2). Additionally, the NEPA point of  
 35       comparison is assumed to occur during the late long-term implementation period and accounts for  
 36       anticipated climate change conditions during that period, whereas the CEQA baseline is assumed to  
 37       occur during existing climate conditions. Therefore, differences in model outputs between the CEQA  
 38       baseline and the action alternative (Alternatives 1A through 9) are due primarily to both the  
 39       impacts of proposed alternative and future climate change conditions (sea level rise and altered  
 40       precipitation patterns).

## 1 **11.0.1.4 Chapter Organization**

2 The chapter is broken out into three parts, the last of which contains the analysis of environmental  
3 impacts:

- 4 1. Environmental Setting and Affected Environment
- 5 2. Regulatory Setting
- 6 3. Environmental Consequences

7 The list of references used to support the environmental setting and impact analysis is contained in  
8 Chapter 34, References.

### 9 **Environmental Setting and Affected Environment, Section 11.1**

10 The first part of the chapter is the Environmental Setting and Affected Environment section. The  
11 section's 120 pages provide a general description of the existing environment, including the  
12 following:

- 13 • Areas of Potential Environmental Effects (Section 11.1.1), which describes the geographic region  
14 where potential effects may be expected to occur with implementation of the alternatives
- 15 • Natural Communities (Section 11.1.2), which describes the natural communities, such as tidal  
16 perennial aquatic natural communities, tidal freshwater emergent wetlands, and tidal mudflats  
17 that could be affected by implementation of the alternatives
- 18 • Species Evaluated in the EIR/EIS (Section 11.1.3) are the species that could be affected by the  
19 alternatives, which were previously listed in this introduction
- 20 • Ecological Processes and Functions (Section 11.1.4) provides an overview of activities  
21 throughout the San Francisco Bay-Delta watershed in order to provide an understanding of  
22 current conditions and the interconnectedness of hydrology throughout the system
- 23 • Stressors (Section 11.1.5) describes actions, environmental characteristics or organisms that  
24 may negatively affect fish and aquatic resources, ecological processes, and habitats.

### 25 **Regulatory Setting, Section 11.2**

26 The second part of the chapter, Regulatory Setting, describes the legal and regulatory setting  
27 applicable to the BDCP, and aquatic resources in particular.

### 28 **Environmental Consequences, Section 11.3**

29 The third part of the chapter describes the anticipated environmental consequences of each of the  
30 15 action alternatives. This part of the chapter is divided into five sections. The first three sections  
31 (Sections 11.3.1 through 11.3.3) provide an important foundation for the analysis of the  
32 environmental effects. The fourth section contains the analysis of each alternative's impacts as well  
33 as associated environmental commitments and mitigation measures that would be implemented to  
34 reduce those impacts. The final section discusses cumulative effects. The five sections are as follows:

- 35 • Impact Mechanisms (Section 11.3.1), which provides a general discussion of the construction,  
36 operations and maintenance activities and processes associated with each group of conservation  
37 measures, and the associated stressors that could potentially affect fish and other aquatic  
38 species.

- 1 • Methods of Analysis (Section 11.3.2), which presents information on how entrainment; flow,  
2 passage, salinity, and turbidity; biological stressors such as invasive aquatic vegetation and fish  
3 predation; contaminants; and habitat restoration are addressed.
- 4 • Determination of Effects (Section 11.3.3), which describes the criteria for determining whether  
5 the alternative creates an impact or effect.
- 6 • Effects and Mitigation Approaches (Section 11.3.4), which provides a full discussion by  
7 alternative (no action alternative and 15 project alternatives) of impacts and mitigation  
8 approaches of the BDCP conservation measures on covered and non-covered fish and aquatic  
9 species. ***Important information about the organization of the Effects and Mitigation***  
10 ***Approaches section is provided below.***
- 11 • Cumulative Effects on Fish and Aquatic Resources (Section 11.3.5) addresses the potential for  
12 the BDCP alternatives to act in combination with other past, present, and probable future  
13 projects or programs to create a cumulatively significant adverse impact.

#### 14 **11.0.1.5 Important Information about the Organization of the Effects and** 15 **Mitigation Approaches Discussion, Section 11.3.4**

16 The Effects and Mitigation Approaches section (Section 11.3.4) contains the analysis of the impacts  
17 and mitigation on covered and non-covered fish and aquatic species for each alternative section  
18 begins with an analysis of the No Action Alternative and is then followed by the action alternatives.  
19 The alternatives and their section numbers are listed below. A discussion of cumulative effects is  
20 included as a standalone section (Section 11.3.5) after Alternative 9.

- 21 • No Action Alternative (Section 11.3.4.1)
- 22 • Alternative 1A (Section 11.3.4.2)
- 23 • Alternative 1B (Section 11.3.4.3)
- 24 • Alternative 1C (Section 11.3.4.4)
- 25 • Alternative 2A (Section 11.3.4.5)
- 26 • Alternative 2B (Section 11.3.4.6)
- 27 • Alternative 2C (Section 11.3.4.7)
- 28 • Alternative 3 (Section 11.3.4.8)
- 29 • Alternative 4 (Section 11.3.4.9)
- 30 • Alternative 5 (Section 11.3.4.10)
- 31 • Alternative 6A (Section 11.3.4.11)
- 32 • Alternative 6B (Section 11.3.4.12)
- 33 • Alternative 6C (Section 11.3.4.13)
- 34 • Alternative 7 (Section 11.3.4.14)
- 35 • Alternative 8 (Section 11.3.4.15)
- 36 • Alternative 9 (Section 11.3.4.16)

1 The discussion of Alternative 1A contained in Section 11.3.4.2, beginning at page 238, contains a  
2 detailed discussion of the impacts of the 16 BDCP conservation measures analyzed in this chapter.

3 To the extent there are similarities between Alternative 1A and the other alternatives, the  
4 subsequent alternative analyses refer back to the Alternative 1A analysis. This approach allows the  
5 analysis of Alternatives 1B through Alternative 9 to minimize redundancy and emphasize those  
6 aspects of the alternatives that are different from Alternative 1A. Hence, readers wishing to gain a  
7 better understanding of the impacts and mitigation for Alternatives 1B through 9 should first  
8 become familiar with the presentation of impacts and mitigation for Alternative 1A. Alternatives  
9 ending in 'B' or 'C' are different from the corresponding 'A' variant of the alternatives. The difference  
10 is the physical type and/or location of water conveyance infrastructure. In all other respects,  
11 including water operations, the 'B' and 'C' variants are identical to the corresponding 'A' variant. For  
12 example Alternative 1B is different from Alternative 1A in that Alternative 1A would convey water  
13 from the north Delta to the south Delta through pipelines/tunnels, while Alternative 1B would  
14 convey water through a surface canal. The effects on covered and non-covered species do not differ  
15 otherwise, so the analysis of the 'B' and 'C' alternatives is condensed and refers the reader back to  
16 the corresponding 'A' alternative for specific details.

17 Restoration and Other Conservation Measures are the same among all but two of the alternatives.  
18 The exceptions are Alternatives 5 and 7. Under Alternative 5, 25,000 acres of tidal habitat would be  
19 restored, compared to 65,000 acres for Alternative 1A. Under Alternative 7, there would be 20,000  
20 acres of seasonally inundated floodplain and 40 miles of channel enhancement, versus 10,000 acres  
21 of seasonally inundated floodplain and 20 miles of channel margin enhancement under Alternative  
22 1A. For the alternatives other than Alternatives 5 and 7, the reader is referred back to Alternative 1A  
23 for details. To help guide the reader, bookmark their location in the chapter, and maintain  
24 consistency with Alternative 1A, the impact headers (i.e., Effects of construction of restoration  
25 measures) are retained in these other alternatives and followed by a general summary in some  
26 instances and cross reference to appropriate analysis located elsewhere in the chapter.

27 The 16 BDCP conservation measures (see Table 3.3 Summary of Proposed BDCP Conservation  
28 Measures of All Action Alternatives in Chapter 3, *Description of Alternatives*) that are analyzed for  
29 each species under each alternative are treated in 4 distinct categories for purposes of impact  
30 analysis. Those categories are as follows:

- 31 ● Potential impacts resulting from construction and maintenance of Conservation Measure (CM) 1  
32 (CM1 provides for the development and operation of a new water conveyance infrastructure  
33 and the establishment of operational parameters associated with both existing and new  
34 facilities).
- 35 ● Potential impacts resulting from water operations of CM1.
- 36 ● Potential impacts resulting from restoration activities (CM2, CM4–CM7, and CM10 – which are  
37 primarily habitat restoration measures that provide for the protection, enhancement and  
38 restoration of habitats and natural communities that support covered species).
- 39 ● Potential impacts resulting from other activities (CM12–CM19 and CM21 – which are primarily  
40 measures to reduce the direct and indirect adverse effects of other stressors on covered  
41 species).

1 The following conservation measures are not included in the analysis because they would not affect  
 2 fish and aquatic resources: CM3 (*Natural Communities Protection and Restoration*), CM8 (*Grassland*  
 3 *Natural Community Restoration*), CM9 (*Vernal Pool Complex Restoration*), CM11 (*Natural*  
 4 *Communities Enhancement and Management*), and CM20 (*Recreational Users Invasive Species*  
 5 *Program*).

6 Within each alternative discussion section, the impacts of the 16 BDCP conservation measures are  
 7 analyzed on a species-by-species basis for covered species and non-covered species in the following  
 8 order:

- 9 • Delta smelt
- 10 • Longfin smelt
- 11 • Chinook salmon, Sacramento River winter-run ESU
- 12 • Chinook salmon, Central Valley spring-run ESU
- 13 • Chinook salmon, Central Valley fall-and late-fall run ESU
- 14 • Steelhead, Central Valley DPS
- 15 • Sacramento splittail
- 16 • Green sturgeon, southern DPS
- 17 • White sturgeon
- 18 • Pacific lamprey
- 19 • River lamprey
- 20 • Non-covered fish and aquatic species

21 Unlike covered species, non-covered species are dealt with in a consolidated manner with one  
 22 exception that is described below. The consolidated discussion for non-covered species is  
 23 appropriate because the effects of construction and maintenance of CM1, restoration activities  
 24 (CM2, CM4–CM7, and CM10), and other activities (CM12–CM19 and CM21) on non-covered fish and  
 25 aquatic species would be similar for all non-covered fish species included in Chapter 11. The  
 26 exception to this is under the discussion of Water Operations of CM1, which analyzes non-covered  
 27 fish and aquatic species individually.

28 A sample outline of the organization of the analysis of the impact of a representative action  
 29 alternative (Alternative 1A) on single covered species (delta smelt) is presented below. Two  
 30 additional impact discussions come after the non-covered species analysis: the effects of water  
 31 operations on reservoir coldwater fish habitat and the potential effects of water transfers on fish  
 32 and aquatic resources. The analyses occur after the discussion of each individual covered fish  
 33 species because they focus on fish and aquatic resources in general and not on a species-by-species  
 34 basis.

1 **11.3.4.2 Alternative 1A – Dual Conveyance with Pipeline/Tunnel and Intakes 1–5**  
 2 **(15,000 cfs; Operational Scenario A)**

3 **Delta Smelt**

- 4 ● Construction and Maintenance of CM1
- 5 ○ Effects of construction of water conveyance facilities
- 6 ○ Effects of maintenance of water conveyance facilities
- 7 ● Water Operations of CM1
- 8 ○ Effects on entrainment
- 9 ○ Effects on spawning habitat
- 10 ○ Effects on rearing habitat
- 11 ○ Effects on migration conditions
- 12 ● Restoration Measures (CM2, CM4–CM7, and CM10)
- 13 ○ Effects of construction of restoration measures
- 14 ○ Effects of contaminants
- 15 ○ Effects of restored habitat conditions
- 16 ● Other Conservation Measures (CM12–CM19 and CM21)
- 17 ○ Effects of methylmercury management (CM12)
- 18 ○ Effects of invasive aquatic vegetation management (CM13)
- 19 ○ Effects of dissolved oxygen level management (CM14)
- 20 ○ Effects of localized reduction of predatory fishes (CM15)
- 21 ○ Effects of nonphysical fish barriers (CM16)
- 22 ○ Effects of illegal harvest reduction (CM17)
- 23 ○ Effects of conservation hatcheries (CM18)
- 24 ○ Effects of urban stormwater treatment (CM19)
- 25 ○ Effects of removal/relocation of nonproject diversion (CM21).

26 This approach is then followed for each of the remaining species listed above and non-covered  
 27 species as a consolidated group. Finally, the analysis of each alternative concludes with a discussion  
 28 of the effects of water operations on reservoir coldwater fish habitat and the potential effects of  
 29 water transfers on fish and aquatic resources.

30 Longer impact discussions that address several subjects, such as five or six waterways for example,  
 31 are broken out by subheaders. The subheaders are meant to help the reader focus on the river or  
 32 creek (or other subject matter). At the end of the discussion is an overall summary that ties to the  
 33 NEPA conclusion. When the reader moves into the CEQA conclusion, the same subheaders are  
 34 repeated and contain the CEQA analysis and ends with an overall CEQA conclusion. Many of these  
 35 impact discussions appear repetitive, but the analysis is different to reflect the different NEPA and

1 CEQA points of comparison (or “baseline” in CEQA terms). These longer discussions are typically  
2 under the section “Water Operations of CM1” in Alternatives 2A, 3, 4, 5, 6A, 7, 8, and 9. An example  
3 of this header structure is provided below for steelhead; it is taken from Alternative 2A.

4 **Impact AQUA-95: Effects of water operations on upstream fry and juvenile rearing habitat for**  
5 **steelhead**

6 General statement about the effect of the alternative on rearing habitat relative to the NEPA point of  
7 comparison.

8 ***Sacramento River***

9 ***Trinity River***

10 ***Clear Creek***

11 ***Feather River***

12 ***American River***

13 Summary of analysis and NEPA conclusion.

14 ***CEQA Conclusion:*** General statement about the effect of the alternative on rearing habitat relative to  
15 the CEQA baseline.

16 ***Sacramento River***

17 ***Trinity River***

18 ***Clear Creek***

19 ***Feather River***

20 ***American River***

21 Summary of analysis and CEQA conclusion.

22

## 1 **11.0.2 Summary of Effects**

### 2 **11.0.2.1 Alternative 1A—Summary of Effects**

#### 3 **Overview**

4 Alternative 1A would convey up to 15,000 cfs of water from the north Delta to the south Delta  
5 through pipelines/tunnels via five screened intakes (i.e., Intakes 1 through 5) on the east bank of the  
6 Sacramento River between River Mile (RM) 44 (south of Freeport) and RM 37 (north of the town of  
7 Courtland). Intakes 1 through 5 would introduce large, multi-story industrial concrete and steel  
8 structures approximately 55 feet in height from river bottom to the top of the structure with a  
9 length of 900–1,600 feet depending on the location.

10 Water supply and conveyance operations would follow the guidelines described as Scenario A,  
11 which does not include Fall X2 requirements. Conservation Measure (CM) 1–CM3 would manage the  
12 routing, timing, and amount of flow through the Delta. CM4–CM11 would restore, enhance, and  
13 manage physical habitats on a natural community scale. CM11–CM22 are designed to reduce *other*  
14 *stressors* on a species scale.

15 The following provides a summary of the major effects of Alternative 1A on covered and non-  
16 covered fish species related to constructing and maintaining CM1, operating CM1, implementing  
17 restoration measures (CM2, CM4–CM7, and CM10) and implementing other stress reducing  
18 conservation measures (CM12–CM19 and CM21).

#### 19 **Construction and Maintenance of CM1**

20 In-water construction and maintenance activities have the potential to injure or kill fish through  
21 direct physical injury, or indirectly through behavioral or habitat alterations. In-water work  
22 activities with the most potential to affect fish would include installation of sheet pile cofferdams  
23 and foundation piles at each intake location, support piles at each barge landing, and placement of  
24 riprap to protect the stream banks adjacent to the intakes from erosion. Impact pile driving, in  
25 contrast to vibratory pile driving, can produce underwater impulsive sound pressure waves that can  
26 damage fish organs and tissues and result in injury or mortality. Fish can be trapped or stranded  
27 inside cofferdams and subject to dewatering or injury during rescue operations, and the placement  
28 of riprap can crush or trap fish. Although fish would likely avoid the noise and activity of pile  
29 installation, riprap placement, and other in-water construction work, these activities have the  
30 potential to result in direct injury or mortality.

31 Covered fish species could also be adversely affected by elevated underwater noise associated with  
32 impact pile driving and direct exposure to construction-related disturbance. The effects of exposure  
33 can range from temporary hearing loss to physical injury sufficient to cause direct mortality. The  
34 degree of effect is a function of the intensity of the sound, the distance from the source, the duration  
35 of exposure, the size of the fish exposed and the species-specific sensitivity. While the number of  
36 individuals affected would typically be minimized by adhering to approved in-water work windows,  
37 and installing the foundation piles inside dewatered or partially dewatered cofferdams, these would  
38 not completely avoid the potential for injury or mortality level exposures. Mitigation Measures  
39 AQUA-1a and AQUA-1b would avoid or minimize adverse effects from impact pile driving. Mitigation  
40 Measure AQUA-1a would involve installing piles by vibratory methods or other non-impact driving

1 methods, wherever feasible; monitoring underwater sound levels to determine compliance with  
2 established underwater noise thresholds, when pile driving is required; and developing a noise  
3 monitoring plan, with appropriate corrective actions if the thresholds are exceeded. Mitigation  
4 Measure AQUA-1b would involve using an attenuation device to reduce the effects of pile driving  
5 and other construction-related underwater noise when pile driving is required.

6 In-water and near-shore construction activities also have the potential to cause adverse effects on  
7 covered species through water quality degradation from increased turbidity, inadvertent spills of  
8 hazardous materials, and disruption of contaminated sediments. However, these adverse effects will  
9 be effectively avoided and minimized by isolating much of the in-water work inside cofferdams,  
10 constructing in areas that have limited use by the covered species, adhering to the approved in-  
11 water work windows, activity-specific timing restrictions, and by implementing environmental  
12 commitments and Best Management Practices (BMPs). These commitments are described in  
13 Appendix 3B, *Environmental Commitments* which include *Conduct Environmental Training*; *Develop*  
14 *and Implement a Stormwater Pollution Prevention Plan (SWPPP)*; *Develop and Implement an Erosion*  
15 *and Sediment Control Plan*; *Develop and Implement a Hazardous Materials Management Plan (HMMP)*  
16 *that includes a Spill Prevention, Containment, and Countermeasure Plan (SPCCP)*; *Dispose of Spoils,*  
17 *Reusable Tunnel Material, and Dredged Material*; *Develop and Implement a Fish Rescue and Salvage*  
18 *Plan*; and *Develop and Implement a Barge Operations Plan*. These environmental commitments  
19 would reduce the amount of turbidity from in-water construction activities and would guide rapid  
20 and effective response in the case of inadvertent spills of hazardous materials. These environmental  
21 commitments would be expected to protect covered fish species from adverse water quality effects  
22 resulting from project construction.

23 Construction would not be expected to measurably increase predation rates, relative to baseline  
24 conditions, because any locally increased predator habitat and predation from temporary  
25 construction structures would not have population level effects.

26 While in-water construction activities would temporarily or permanently alter migration, spawning,  
27 and rearing habitat conditions in the vicinity of the construction activities, the extent of the overall  
28 available habitat affected, and the relatively poor quality of the affected habitat, is expected to limit  
29 the effects of construction and maintenance activities on most covered fish species. Thus the effects  
30 would not be limiting to population productivity.

31 In addition to the effects of habitat alterations, in-water construction activities could also result in  
32 behavioral effects. Such effects would include migration delays, displacement of fish from preferred  
33 habitats, and disturbance of spawning or foraging activities. As with other construction-related  
34 effects, these effects are expected to be limited, although they cannot be entirely discounted.

35 The potential for construction and maintenance activities to affect the covered fish species would  
36 typically be proportional to the number of north Delta intakes constructed, and the total area of  
37 habitat affected. Alternative 1A includes the construction of the five north Delta intake facilities and  
38 six temporary barge landings to support construction of six tunnel shafts and pipeline construction.  
39 The locations, dimensions, and construction footprints of the intakes considered in Alternative 1A  
40 are provided in Table 11-1A-SUM1.

1 **Table 11-1A-SUM1. Number and Sizes of In-Water Structures and Area of Habitat Affected by**  
 2 **Construction Activities by Alternatives**

Alternatives	Intakes	Barge Landings	Temporary Construction Effects (acres)	Total Shoreline Habitat Permanently Affected by Intake (feet)	Total Intake Footprint (acres)	Offshore Habitat Dredged (acres)
1A	1-5	6	28.7	11,900	21.8	27.3
1B	1-5	1	28.7	11,900	21.8	27.3
1C	W1-W5	2	32.7	10,100	24.9	20.3
2A	1-5 or 1,2,3,6,7	6	27.1-28.7	11,350-11,900	7.1-7.7	26.0
2B	1-5 or 1,2,3,6,7	1	27.1-28.7	11,350-11,900	7.1-7.7	26.0
2C	W1-W5	2	32.7	10,100	24.9	20.3
3	1 and 2	6	11.0	4,450	8.3	10.2
4	1, 2, and 3	6	16.2	6,360	12.3	17.1
5	1	6	5.0	2,050	3.8	4.7
6A	1-5	6	28.7	11,900	21.8	27.3
6B	1-5	1	28.7	11,900	21.8	27.3
6C	W1-W5	2	32.7	10,100	24.9	20.3
7	2, 3, and 5	6	18.1	7,450	13.7	17.0
8	2, 3, and 5	6	18.1	7,450	13.7	17.0
9	None <sup>a</sup>	5	31.4 <sup>a</sup>	4,800 <sup>a</sup>	15.4 <sup>a</sup>	56.9

<sup>a</sup> Aquatic habitat impacts for structures other than intakes.

3

4 At each Alternative 1A intake, between 1.2 and 6.9 acres of river area would be isolated behind  
 5 cofferdams, and temporarily or permanently lost. During the in-water construction period, a total of  
 6 up to about 28.7 acres of in-water habitat and 22,700 linear feet of primarily steep-banked and  
 7 riprapped shoreline habitat would be affected by construction and dredging activities. This would  
 8 result in the loss or alteration of low-quality spawning, rearing, and migration habitat for covered  
 9 fish species. The barge landings would include in-water and over-water structures, each occupy  
 10 approximately 15,000 square feet of shoreline habitat within their respective Delta channels.

11 In-water work activities at the north Delta intakes would include installation of sheet pile  
 12 cofferdams at each intake location to isolate active construction activities from the Sacramento  
 13 River and minimize potential for increases in turbidity. Although fish would likely avoid the noise  
 14 and activity of sheet pile installation, cofferdams have the potential to entrap some fish. Overall  
 15 effects would also be minimized through the implementation of environmental commitment *Fish*  
 16 *Rescue and Salvage Plan* (see Appendix 3B, *Environmental Commitments*), with detailed procedures  
 17 for fish rescue and salvage to minimize the number of fish stranded during placement and removal  
 18 of cofferdams at the intake construction sites (see Appendix 3B, *Environmental Commitments*).

19 Once constructed, the new facilities will require periodic maintenance to function effectively,  
 20 resulting in short-term effects on the environment that would occur at a variable frequency  
 21 depending on planned and unplanned maintenance needs. The effects of maintenance activities are  
 22 expected to be similar to those described for project construction. However, the scale of those  
 23 effects will be commensurate with the nature and extent of the maintenance activities conducted  
 24 during any given year. Project maintenance would include the same range of conservation measures

1 and environmental commitments (see Appendix 3B, *Environmental Commitments*) BMPs used  
2 during project construction to avoid and minimize adverse effects on fish and aquatic habitats. The  
3 maintenance activity with the most potential to affect the covered fish species is periodic dredging  
4 adjacent to the intakes, which would reduce habitat quality, prey abundance and water quality  
5 conditions. As with the construction effects, these areas would recover relatively quickly and  
6 represent only a small portion of the available habitat in the Delta. Therefore, the effects would  
7 likely be limited to the areas at and immediately adjacent to location of the intakes.

8 In addition to the environmental commitments and BMPs discussed above, the potential effects of  
9 construction and maintenance activities would vary by species, based on their tolerance to the  
10 mechanisms of effect or their expected occurrence near the construction areas during the in-water  
11 construction window. For example, delta smelt, longfin smelt, Sacramento splittail, sturgeon, and  
12 lamprey are all tolerant of increased turbidity, thereby minimizing this potential construction and  
13 maintenance activity effect. The effects on delta smelt would also be limited by their distribution  
14 (primarily in the west Delta region) and expected occurrence in the construction areas during only  
15 the early portion of the work window (June and early July). Similarly, longfin smelt occur primarily  
16 downstream of the construction areas, thereby substantially limiting the potential for effects.

17 The in-water construction window would limit construction and maintenance activities to when the  
18 least number of salmonids would occur in the area, although some species or life stages could occur  
19 in greater numbers during portions of the construction window. Adult fall-run Chinook salmon  
20 would be migrating upstream during a substantial portion of the in-water construction window, and  
21 the primary mechanism of effect would be the noise generated by pile driving activities, which could  
22 result in migration delays. However, adult fall-run Chinook salmon are expected to be migrating  
23 relatively quickly through the area, and pile driving would occur intermittently through only about 8  
24 hours per day, thereby limiting any potential for substantial migration effects.

25 The relatively poor habitat at the intake and barge landing locations, due to steep riprap banks and  
26 deep channels with little refuge or holding areas, would further limit the overall occurrence  
27 (abundance and/or duration) of both juvenile and adult salmonids. Despite the poor quality of the  
28 existing habitat, it is designated critical habitat for Chinook salmon and steelhead, and the  
29 construction and maintenance activities would further degrade the habitat either temporarily or  
30 permanently. However, implementation of CM6 *Channel Margin Enhancement* would enhance  
31 channel margin habitat along 20 miles of the Sacramento River, including the vicinity of the intake  
32 structures, and is designed to result in a net improvement in channel margin habitat function.  
33 Therefore, the temporary and permanent effects on rearing and migration habitat would not  
34 adversely affect Chinook salmon or steelhead populations. In addition, no spawning habitat occurs  
35 in the areas potentially affected by construction and maintenance activities, and ample rearing and  
36 migration habitat of the same quality is readily accessible in the area.

37 Despite adhering to the approved in-water work window timing restrictions, a moderate number of  
38 green and white sturgeon are expected to occur in the construction and maintenance areas, and  
39 potentially affected by the associated activities. In particular, pile driving noise could result in  
40 significant impacts to individual juvenile sturgeon, although implementation of Mitigation Measures  
41 AQUA-1a and AQUA-1b would reduce the severity of potential effects. As bottom oriented fish,  
42 sturgeon are also particularly susceptible to injury from dredging activities, although the infrequent  
43 occurrence of dredging activities and the limited numbers of sturgeon expected to occur in the area  
44 would result in a low potential for effects. Therefore, construction and maintenance activities are  
45 not expected to adversely affect green or white sturgeon.

1 Pacific and river lamprey are also expected to occur in the construction and maintenance areas  
 2 during the typical in-water construction window, and could be affected by these activities. Due to  
 3 the atypical hearing structures on lamprey, compared to other fish, and the behavior of ammocoetes  
 4 to burrow into the substrate, the potential effects of pile driving noise is uncertain. The burrowing  
 5 behavior of lamprey ammocoetes could also put them at particular risk from stranding within the  
 6 intake cofferdams, although implementation of environmental commitment 3B.8-Fish Rescue and  
 7 Salvage Plan would minimize potential effects. Lamprey are also expected to be susceptible to injury  
 8 from dredging, although the infrequent occurrence and limited areas dredged would minimize the  
 9 overall effects. The potential effects of Alternative 1A on the non-covered aquatic species of primary  
 10 management concern would be generally similar to those discussed above for the covered species.

11 In summary, construction and maintenance activities would result in limited temporary and  
 12 permanent effects on the covered fish species or their habitat. While these effects would vary by  
 13 species and species life stages, the implementation of environmental commitments and BMPs (see  
 14 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
 15 not adverse and less than significant. In addition, the implementation of Mitigation Measures AQUA-  
 16 1a and AQUA 1b would reduce the severity of pile driving noise effects on all the covered species, to  
 17 be not adverse and less than significant. The implementation of habitat restoration activities,  
 18 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
 19 the intake sites.

## 20 **Water Operations of CM1**

21 Water operations vary between the alternatives due to conveyance infrastructure differences (e.g.,  
 22 five north Delta intakes vs. one north Delta intake) and the flow scenario differences (e.g., higher or  
 23 lower average annual exports, the point of diversion for those exports, and the seasonality of those  
 24 exports). Consistent with the operational scenarios fully described in Chapter 3, Project Alternatives,  
 25 water operations under Alternative 1A (operational Scenario A) could result in changes in flow,  
 26 water quality, habitat, impingement, entrainment, and predation. Operational impacts on fish may  
 27 include changes in spawning, migration, and rearing habitat associated with changes in Sacramento  
 28 River and tributary flows due to reservoir operations, water diversions, and the consequent changes  
 29 in water quality and circulation through the Delta. Overall changes in the rate of entrainment or  
 30 impingement of fish would be associated with the north Delta intakes and the change in diversions  
 31 at the south Delta facilities. Placement and operation of the north Delta intakes may also result in  
 32 changes in fish predation. Following is a summary discussion of these types of effects based on the  
 33 analysis of Alternative 1A.

## 34 ***Changes in Exports and Outflow***

35 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
 36 Alternative 1A are anticipated to increase by 312 thousand acre-feet (TAF) relative to Existing  
 37 Conditions, and by 1,015 TAF relative to the No Action Alternative (NAA). Over the long-term,  
 38 approximately 50% of the exported water will be from the new north Delta intakes, and average  
 39 monthly diversions at the south Delta intakes would correspondingly decrease. These changes  
 40 would increase the proportion of San Joaquin River water flowing throughout the South, West, and  
 41 Interior Delta, and a corresponding decrease in the proportion of Sacramento River water.

42 Under Alternative 1A, long-term average annual Delta outflow is anticipated to decrease 323 TAF  
 43 relative to Existing Conditions and by 1,072 TAF relative to the NAA. It is important to note that  
 44 some outflow changes under Alternative 1A are greater relative to the NAA because the NAA

1 includes operations to meet Fall X2, whereas Existing Conditions and Alternative 1A do not. This will  
2 vary among alternatives, as some alternatives do include operations to meet Fall X2.

3 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
4 diverted December through mid-June and less water diverted mid-June through November), there  
5 would be beneficial, not adverse/less than significant, and adverse/significant and unavoidable  
6 effects/impacts on fish under Alternative 1A. Following is a summary of these effects as they relate  
7 to the key factors of entrainment and flow, which in turn affects fish survival and spawning, rearing,  
8 and migration habitat conditions.

### 9 ***Entrainment***

10 Overall entrainment of delta smelt, longfin smelt, and splittail under Alternative 1A would be less  
11 than or similar to the levels experienced in the recent years. This is because the north Delta  
12 diversion operations would reduce reliance on south Delta export facilities (greater entrainment  
13 rates are expected to occur at south Delta facilities), along with additional minor benefits from  
14 decommissioning of agricultural diversions in restoration areas and implementation of an  
15 alternative intake for the North Bay Aqueduct. While some delta smelt and longfin smelt losses may  
16 occur from entrainment and impingement at the north Delta diversions, these would be relatively  
17 low due to the state-of-the-art positive barrier fish screens and these species primarily occur  
18 downstream of the diversion sites.

19 Similarly, overall entrainment losses of juvenile salmonids under Alternative 1A generally would be  
20 appreciably lower than under Existing Conditions because the north Delta diversion operations  
21 reduce reliance on south Delta export facilities. As a result, reduced entrainment of juvenile  
22 salmonids would occur in the majority of years under wetter conditions, and would be beneficial or  
23 not adverse, whereas in dry and critical water years overall entrainment is increased relative to that  
24 under current conditions, and would be adverse for some species (i.e., spring-run Chinook salmon).  
25 In contrast, the effects on entrainment of winter-run Chinook and steelhead would be beneficial.

26 Entrainment of white and green sturgeon at south Delta facilities under Alternative 1A will be  
27 substantially reduced in wetter water years and moderately reduced in drier water years. The  
28 negligible reductions in entrainment in agricultural diversions are not expected to affect sturgeon  
29 populations. While the potential entrainment of larval sturgeon at the north Delta facility raises  
30 some uncertainty of the overall change in entrainment rate, this uncertainty would be addressed  
31 through monitoring and adaptive management actions. Based on available information, overall  
32 entrainment effects on green sturgeon are not expected to substantially change under Alternative  
33 1A. Finally, Alternative 1A is expected to slightly reduce Pacific and river lamprey entrainment due  
34 to reductions in south Delta exports and decommissioning agricultural diversions.

35 While the proposed north Delta intakes under Alternative 1A will have state-of-the-art fish screens  
36 to minimize entrainment, they will have the potential to affect some fish species through contact  
37 with the screens and/or increased predation around those facilities. However, these effects are  
38 considered to be not adverse.

39 In summary, entrainment is expected to remain at or below the levels currently experienced by  
40 most fish species and life stages in the Delta. There are some instances where there would be  
41 increases, but these would be at least partially offset by decreases during other periods. In addition,  
42 monitoring and adaptive management actions would be implemented to verify entrainment rates

1 and modify operations or structures to minimize effects. Therefore, the overall the effects are not  
2 adverse and less than significant.

### 3 **Flows**

4 While San Joaquin River flows are not expected to be affected by Alternative 1A, flow changes are  
5 expected in the Sacramento River and its tributaries, as well as within the Sacramento-San Joaquin  
6 Delta. Changes in flow will result from changes in releases from upstream reservoirs, diversions  
7 from the south Delta, and reductions in flows downstream of the proposed north Delta intakes.

8 The area of fall abiotic habitat for juvenile delta smelt in the open-water areas of the Suisun Bay,  
9 Suisun Marsh, and West Delta subregions would be less under Alternative 1A than under NAA  
10 conditions that include the Fall X2 flows because of lower outflow. However, this area would  
11 increase in size relative to Existing Conditions without the Fall X2 flows. The reduction in fall abiotic  
12 habitat area in the open estuary would be offset by tidal marsh habitat restoration, assuming the  
13 intended habitat benefits are realized, when considered across all water year types, relative to both  
14 Existing Conditions and NAA, but not entirely for NAA. However, if the proposed habitat restoration  
15 does not produce the intended benefits to delta smelt, the abiotic habitat index under Alternative 1A  
16 would decrease 22% on average compared to NAA. Such reductions result from Operational  
17 Scenario A, which does not include Fall X2 requirements, while the NAA does. Based on these  
18 uncertainties, the overall effect is uncertain.

19 Decreased winter-spring outflows under Alternative 1A have the potential to contribute to  
20 decreases in longfin smelt abundance from reduced larval transport flows and spring habitat  
21 quantity and quality for larval and early juvenile longfin smelt in the Suisun Marsh and West Delta  
22 subregions. This analysis does not take into account any potential changes in spawning or rearing  
23 conditions related to non-operational components of Alternative 1A, including habitat restoration.  
24 As a result, the overall effects on rearing and migration conditions are uncertain.

25 With regard to salmonids, several issues were identified as described below, to be adverse. For  
26 example, Sacramento River attraction flows for migrating adult salmonids would be lower from  
27 operations of the north Delta diversions under Alternative 1A. Winter-run Chinook salmon would  
28 likely experience adverse effects to spawning, rearing and migration habitat conditions, with greater  
29 redd dewatering and lower weighted usable spawning area under Alternative 1A; the OBAN life  
30 cycle model also indicates potentially adverse effects on winter-run Chinook salmon from changes in  
31 upstream flow and water temperature. Proposed adaptive management mitigation measures have  
32 the potential to reduce the severity of the impacts, though not necessarily to a less than significant  
33 level.

34 Egg mortality for spring-run Chinook salmon in the Sacramento River would be higher under  
35 Alternative 1A, resulting in significant and adverse impacts. The through-Delta effects on juvenile  
36 spring-run Chinook salmon migration conditions would also be adverse due to predation and  
37 habitat loss associated with the five north Delta intake facilities. While implementation of the  
38 proposed conservation and mitigation measures would reduce the severity of effects, they would  
39 not necessarily reduce the impacts to a level considered not adverse or less than significant.

40 Despite some beneficial reductions in the entrainment of fall- and late fall-run Chinook salmon and  
41 steelhead, and no adverse effects on spawning conditions, Alternative 1A would result in significant  
42 and adverse reductions in adult and juvenile migration habitat conditions. The implementation of

1 conservation measures and adaptive management mitigation measures would likely reduce the  
2 severity of these effects, although these would likely still be significant and/or adverse.

3 In addition to the benefits provided to salmonids, improved flow conditions over the Fremont Weir  
4 and in the Yolo Bypass provide substantial benefits to Sacramento splittail.

5 Alternative 1A would maintain upstream spring flows in the Sacramento River, where high flows  
6 have been positively correlated with improved recruitment of juvenile white sturgeon. However,  
7 Alternative 1A would also reduce April and May Delta outflow, which has been correlated with  
8 reduced year class strength of white sturgeon, in some water year types. However, this relationship  
9 was reached in the absence of north Delta intakes and the exact mechanism that causes this  
10 correlation is not known at this time. The scientific uncertainty regarding which mechanisms are  
11 responsible for the positive correlation between year class strength and river/Delta flow will be  
12 addressed through targeted research and monitoring to be conducted in the years leading up to the  
13 initiation of north Delta facilities operations. It was assumed that the same relationship applies to  
14 green sturgeon in the analysis. Because all other analyses for white sturgeon migration indicates  
15 that there was no adverse effect, the overall effects are uncertain due to the uncertainty of the Delta  
16 outflow relationship. Because other analyses indicate that there would be adverse effects on green  
17 sturgeon migration, the overall conclusion is that the effect would be adverse, relative to NAA. The  
18 effects on green sturgeon would also be significant and unavoidable, relative to Existing Conditions. .

19 Alternative 1A also has the potential to adversely reduce suitable spawning habitat and also the  
20 number of Pacific lamprey, as a result of egg mortality from increased dewatering risks and  
21 increased water temperatures. In contrast, Alternative 1A would not result in adverse effects on  
22 river lamprey spawning or incubation habitat conditions, although the reduced amount of rearing  
23 habitat and increased temperature-related ammocoete mortality would be adverse. Despite these  
24 significant and unavoidable effects, proposed adaptive management mitigation has the potential to  
25 reduce the severity of impact, though not necessarily to a less than significant level.

26 As evidenced by this summary, some changes in flow under Alternative 1A are adverse to fish  
27 species. Alternative 1A also includes conservation measures that provide substantial habitat  
28 improvements for fish, and adaptive management mitigation measures to reduce the overall  
29 severity of effects. These measures include habitat restoration measures and several other measures  
30 that reduce existing fish stressors in the Delta region (summary description provided in the  
31 following section). When the flow, habitat restoration, and adaptive management measures are  
32 considered together, the effects of Alternative 1A measures are primarily beneficial or not adverse  
33 and/or less than significant for most covered fish species. However, some effects remain adverse  
34 and/or significant and unavoidable, particularly for the salmonid species. Summary Table 11-1A-  
35 SUM2 presents the results of the flow related effects on fish.

1 **Table 11-1A-SUM2. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	B/LTS	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	NA/LTS		ND/LTS (combined)	
Winter-Run Chinook salmon	B/B	A/SU	A/SU	A/SU
Spring-Run Chinook salmon	A/S	A/SU	NA/LTS	A/SU
Fall-Run/Late Fall-Run Chinook salmon	NA/B	NA/LTS	NA/LTS	A/SU
Steelhead	B/B	NA/LTS	NA/LTS	A/SU
Sacramento splittail	NA/LTS	NA/LTS	B/B	NA/LTS
Green sturgeon	NA/LTS	NA/LTS	NA/LTS	A/SU
White sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	A/SU	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	A/SU	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = No Determination.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 Alternative 1A restoration measures include: Yolo Bypass fisheries enhancement (CM2); 65,000  
5 acres of restored tidal natural communities within BDCP Restoration Opportunity Areas (ROAs)  
6 (CM4); 10,000 acres of seasonally inundated floodplain habitat within the north, east, and/or south  
7 Delta ROAs (CM5); 20 linear miles of channel margin habitat enhancement in the Delta (CM6); 5,000  
8 acres of restored native riparian forest and scrub habitat (CM7); and 1,200 acres of nontidal marsh  
9 restoration and 320 acres of managed wetlands (CM10).

10 The overall intent of Alternative 1A is to improve conditions for covered fish species. For NEPA and  
11 CEQA purposes all affects are not adverse or less than significant, respectively, or beneficial.

12 **Construction of Restoration Measures**

13 In-water and shoreline restoration activities may result in short-term adverse effects on covered  
14 and non-covered fish species through direct disturbance, short-term water quality impacts  
15 (turbidity, spills), and increased exposure to contaminants associated with the incidental  
16 disturbance of contaminated soils and sediments. These effects would be minimized by limiting  
17 construction of restoration activities to the approved in-water construction window, when the least  
18 numbers of covered fish species would be present in or near the restoration sites. The construction  
19 of restoration measures would not involve impact pile driving so those noise effects would not  
20 occur. Some noise would occur from boat and barge traffic and construction equipment; however  
21 the level of this noise would not adversely affect the covered fish species. Turbidity effects would be  
22 minimized by construction windows and implementation of environmental commitments described  
23 in Appendix 3B, *Environmental Commitments*. Additionally, delta smelt and longfin smelt have a high  
24 turbidity tolerance which is unlikely to be exceeded. Appendix 3B, *Environmental Commitments*,  
25 would also guide rapid and effective response in the case of inadvertent spills of hazardous

1 materials thereby minimizing and containing their affect. With respect to incidental disturbance of  
 2 contaminated soils and sediments, the effects on the bioavailability of contaminants is expected to  
 3 be minimal, and if there are effects, they would likely be localized, sporadic, and of low magnitude.  
 4 Additionally, implementation of the environmental commitments described in Appendix 3B,  
 5 *Environmental Commitments*, would minimize or eliminate effects on covered and non-covered fish  
 6 species. As a result, the effects of construction of restoration measures are not adverse and are less  
 7 than significant for covered and non-covered fish species.

#### 8 ***Contaminants Associated with Restoration Measures***

9 Contaminants addressed include methylmercury, selenium, copper, and pesticides. Methylmercury  
 10 likely would be generated by inundation of restoration areas, with highest concentrations expected  
 11 in the Yolo Bypass, Cosumnes/Mokelumne Rivers, and at other ROAs closest to these source areas.  
 12 However, implementation of CM12 *Methylmercury Management* would help to minimize increased  
 13 mobilization of methylmercury at restoration areas. Modeling of water operations effects showed  
 14 little change in methylmercury concentrations in water; however, methylmercury concentrations  
 15 would continue to exceed criteria under the alternatives as they do under Existing Conditions. While  
 16 substantial uncertainty surrounds the potential increase in methylmercury due to BDCP restoration  
 17 actions, implementation of CM12 would likely reduce potential increases.

18 Covered fish species are expected to have low exposure to selenium from sources in the south Delta  
 19 because of the limited frequency and duration and spatial extent of restoration activities. Although  
 20 localized, short-term increases in copper concentrations are possible near ROAs, the length of time  
 21 and the concentrations cannot be determined with available data. However, copper concentrations  
 22 are generally low in Delta waters, and Alternative 1A is not expected to result in increased effects of  
 23 copper on covered fish species. Further, no appreciable addition or mobilization of ammonia to the  
 24 aquatic system would result from restoration activities. The removal of some agricultural areas  
 25 through restoration activities would eliminate those sources and concentrations of copper and  
 26 organophosphate and organochlorine pesticides, providing a long-term net benefit to the ecosystem  
 27 although localized remobilization may occur and local evaluations would be necessary. In addition,  
 28 implementing CM19 *Urban Stormwater Treatment* would provide for treatment of stormwater  
 29 discharges, a major contributor of pyrethroids to the Delta. Thus BDCP may result in reduced  
 30 loading of contaminants. Therefore, the effect of BDCP on these chemical contaminants would not be  
 31 adverse and would be less than significant for covered fish species.

#### 32 ***Restored Habitat Conditions***

33 The effects of restored habitat conditions (CM2 *Yolo Bypass Fisheries Enhancement*, CM4 *Tidal*  
 34 *Natural Community Restoration*, CM5 *Seasonally Inundated Floodplain Restoration*, CM6 *Channel*  
 35 *Margin Enhancement*, and CM7 *Riparian Natural Community Restoration*) would be beneficial for all  
 36 covered fish species because there would be an increase in the amount of habitat as well as food  
 37 production in, and export from, the restored areas. CM10 *Nontidal Marsh Restoration* would provide  
 38 a benefit to covered fish species through a small increase in food export from the restored areas.  
 39 Additional information for each conservation measure is provided below. Note that despite the  
 40 improvements in habitat and habitat functions in the Delta from these restored habitat conditions,  
 41 habitat quality is expected to decline in the late long-term (LLT) primarily because of climate  
 42 change. However, the overall effect of restoration activities is expected to remain beneficial for  
 43 covered fish species.

1 CM2 *Yolo Bypass Fisheries Enhancement* would change the configuration and operation of Fremont  
2 Weir and the Yolo Bypass and restore to a considerable extent the south Delta floodplain. This  
3 would increase the duration and magnitude of seasonal floodplain inundation with an increase in  
4 frequency, duration and magnitude in the Yolo Bypass. Flow modeling results indicate that under  
5 Existing Conditions, at least 3,000 acres of the Yolo Bypass are inundated for at least seven days in  
6 about four out of every five years, on average, and about seven out of every eight years, on average  
7 under Alternative 1A. There would also be fish passage improvements at the Fremont Weir. The  
8 increased inundation would provide increased habitat and would increase production of  
9 periphyton, phytoplankton, zooplankton, macroinvertebrates, insects, and small fish that contribute  
10 to the Delta's pelagic foodweb. This increased food would be available in the Yolo Bypass and would  
11 also be exported and available downstream. Delta smelt and longfin smelt would primarily benefit  
12 from the downstream export of food to portions of the system used by them. Chinook salmon and  
13 possibly steelhead would benefit from the increased Yolo Bypass habitat as well as reductions in  
14 migratory delays and losses (via stranding or poaching) at the Fremont Weir. Pacific lamprey and  
15 river lamprey macrophthalmia and adult passage would also be considerably improved at Fremont  
16 Weir. The enhancements would also improve passage and habitat for Sacramento splittail, green  
17 sturgeon, and white sturgeon. For Sacramento splittail there would also be enhanced spawning and  
18 rearing habitat within the Yolo Bypass. The Yolo Bypass would potentially provide temporary  
19 habitat for green sturgeon and white sturgeon but would not be a substantial benefit. Pacific  
20 lamprey and river lamprey do not substantially use floodplains so the Yolo Bypass enhancements  
21 would have limited beneficial effect on them.

22 CM4 *Tidal Natural Channel Community Restoration* would provide 65,000 acres of habitat. This  
23 acreage provides substantial additional habitat and food production. Similar to the Yolo Bypass this  
24 additional food would be available within the restored areas and would also be exported to adjacent  
25 portions of the Delta. Delta smelt, Chinook salmon, and possibly steelhead would benefit from  
26 substantial increases in habitat and food production. Tidal habitat restoration may increase delta  
27 smelt exposure to the toxic blue-green alga microcystis and provide additional opportunities for  
28 invasive mollusks, including *Corbicula* and *Corbula*, to colonize in delta smelt habitat, affecting delta  
29 smelt food availability. A small proportion of late-stage longfin smelt larvae would benefit from  
30 shallow tidal environments and would experience direct benefits from habitat expansion and food  
31 production. Tidal restoration provides substantial increases in habitat for foraging juvenile  
32 salmonids and Sacramento splittail. Green and white sturgeon would benefit slightly from increased  
33 tidal habitat but would receive additional benefit from the export of food from the restored areas.  
34 Little is known about Pacific lamprey and river lamprey use of tidal communities; however  
35 increased food production is assumed to increase food for lamprey ammocoetes which are filter  
36 feeders.

37 CM5 *Seasonally Inundated Floodplain Restoration* would provide an additional 10,000 acres of  
38 seasonally inundated habitat. The effects would be similar to those summarized above for CM2 *Yolo*  
39 *Bypass Fisheries Enhancement* except that the inundated acreage and benefits would be  
40 proportionally greater.

41 CM6 *Channel Margin Enhancement* would provide 20 miles of channel margin improvement in the  
42 Delta by improving channel geometry, restoring associated habitats on the waterside of levees along  
43 channels, and improving habitat complexity. Delta smelt would get limited benefits from channel  
44 margin enhancements because they are largely found offshore and downstream of these  
45 enhancement areas. Longfin smelt would get access to some additional spawning and rearing  
46 habitat but this would be minimal because they tend to occur away from shore and are largely found

1 downstream of the main channels where enhancement would occur. This enhanced channel margin  
2 provides beneficial rearing and outmigration habitat for juvenile salmonids (Chinook salmon,  
3 steelhead). Chinook salmon fry have a high affinity for channel margins and the enhancements  
4 would provide important refuge from high flows and cover from predators. Sacramento splittail  
5 would also benefit from enhanced channel margins during migration and from the refuge during  
6 high flows. Green sturgeon and white sturgeon would benefit from increased rearing habitat and  
7 improved migration conditions. However, the benefits for the sturgeons are expected to be minimal  
8 because they spend relatively short periods in these shallow near-shore areas. Although little is  
9 known about Pacific lamprey and river lamprey use of channel margin habitat, the species may  
10 benefit from enhancement that increases the area of non-revetted substrate into which ammocoetes  
11 can bury.

12 Channel margin habitat enhancement also has the potential to increase habitat for nonnative fishes  
13 such as largemouth bass that prey on or compete with covered fish species, particularly delta smelt,  
14 longfin smelt, Chinook salmon, and steelhead. Enhancement of channel margins with inundated  
15 vegetation or woody material may also increase predation risk if other features of the habitat  
16 support predatory fish (e.g., relatively steep slopes and deeper water). Monitoring from bank  
17 protection projects and other future studies will inform site designs to limit the potential increase in  
18 nonnative fishes.

19 *CM7 Riparian Natural Community Restoration* would provide 5,000 acres of restored native riparian  
20 forest and scrub habitat along river channels. This restoration would provide shading and  
21 associated thermal refugia; nearshore habitat complexity, including downed wood for resting and  
22 refuge; and would potentially increase food availability through provision of terrestrial insects and  
23 particulate organic matter. Delta smelt and longfin smelt would receive limited benefit because they  
24 occur offshore but they would benefit from food production, and longfin smelt would have access to  
25 some additional rearing habitat. Chinook salmon, steelhead and Sacramento splittail would benefit  
26 from the improved habitat and food production along migration corridors. Green sturgeon and  
27 white sturgeon rely on riparian habitats and juvenile sturgeon would particularly benefit from the  
28 improved habitat quality and quantity as well as the food production. Pacific lamprey and river  
29 lamprey would benefit from additional food production but it is uncertain if they would directly  
30 benefit from the improved riparian habitat.

31 *CM10 Nontidal Marsh Restoration* would provide 1,200 acres of nontidal marsh and 320 acres of  
32 managed wetlands. Since these are upland communities they would primarily provide indirect  
33 benefits to covered and non-covered fish species in the main river systems and Delta. Upland  
34 wetlands provide hydrologic and water quality functions (e.g., storing water during floods, filtering  
35 contaminants), and these sites would provide some additional food resources such as insects,  
36 zooplankton, phytoplankton and dissolved organic carbon when these upland areas are  
37 hydrologically connected to the river system. Although the contribution from the restored acreages  
38 would be small, it would be beneficial to covered and non-covered fish species

39 The overall effects of all restored habitat conditions would be beneficial for covered and non-  
40 covered fish species.

## 1 **Other Conservation Measures (CM12–CM19 and CM21)**

### 2 ***Methylmercury Management (CM12)***

3 Under CM12 *Methylmercury Management*, the BDCP Implementation Office will minimize conditions  
4 that promote production of methylmercury in restored areas and its subsequent introduction to the  
5 foodweb, and to covered fish species in particular. It describes pre-design characterization, design  
6 elements, and best management practices to mitigate methylation of mercury, and requires  
7 monitoring and reporting of observed methylmercury levels. Modeling of Alternative 1A water  
8 operations effects show little changes in methylmercury concentrations in water or fish tissue,  
9 although methylmercury concentrations in both media would continue to exceed criteria under the  
10 BDCP alternatives as they do under Existing Conditions. Consequently, these effects would not be  
11 adverse and are less than significant.

### 12 ***Invasive Aquatic Vegetation Management (CM13)***

13 Control of invasive aquatic vegetation (IAV) would reduce habitat that supports predatory fish in  
14 freshwater near-shore habitat in the Delta. Largemouth bass are strongly associated with dense IAV  
15 beds. A decrease in IAV in the Delta should open up near-shore habitats used by covered fish species  
16 while reducing their encounters with piscivorous predators like largemouth bass. Dense IAV cover  
17 has also been associated with reduction of water turbidity in the Delta. Removal of IAV may also  
18 provide increased turbidity, which is associated with reduced hunting success of visual predators  
19 like largemouth bass and striped bass.

20 The control of IAV would provide a benefit to covered fish species but in particular to Chinook  
21 salmon and steelhead which are especially affected by this predation. The benefit to green sturgeon  
22 and white sturgeon might be lower compared to other covered fish species because rapid sturgeon  
23 growth allows them to relatively quickly outgrow the size range where they are vulnerable to  
24 predation (Gadomski and Parsley 2005). Sturgeon also have a protective amour-like plating  
25 potentially making them unappealing to predators even at a young age (French et al. 2010).

### 26 ***Dissolved Oxygen Level Management (CM14)***

27 CM14 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would improve the  
28 upstream migration conditions for fall-run Chinook salmon and steelhead in the San Joaquin River  
29 basin as well as for Pacific lamprey and river lamprey macrophthalmia and adult passage and for  
30 green and white sturgeon. The other covered fish species occur in the channel and the increased  
31 dissolved oxygen levels also provide improved habitat conditions for them which would be a benefit.  
32 Consequently, the overall effects are beneficial.

### 33 ***Localized Reduction of Predatory Fish (CM15)***

34 To the extent that localized predator control efforts of *CM15 Localized Reduction of Predatory Fish*  
35 reduce the overall abundance of fish predators in the Delta occupied by covered fish species, it is  
36 possible, but not assured that there would be some reduction in losses to predation, although little  
37 quantitative information is available regarding the current magnitude of loss to predation for many  
38 fish species. Due to these uncertainties, there would be no demonstrable effect of this conservation  
39 measure on covered fish species.

### 1 **Nonphysical Fish Barriers (CM16)**

2 CM16 *Nonphysical Fish Barriers (NPBs)* would be implemented to improve survival of out-migrating  
3 juvenile salmonids (Chinook salmon and steelhead) by using NPBs to direct fish away from channels  
4 in which survival is lower. Such barriers may use a combination of sound, light, and bubbles at the  
5 head of Old River, Delta Cross Channel (DCC), Georgiana Slough and possibly Turner Cut and  
6 Columbia Cut. NPBs at these locations have a high potential to deter juvenile salmonids from using  
7 specific channels/migration routes that contribute to decreased survival resulting from increased  
8 predation and/or entrainment or to direct juvenile salmonids to areas that may increase their  
9 survival such as Yolo Bypass. Other locations may be considered if future research indicates the  
10 likelihood of differential survival rates.

11 NPBs at the channel entrance upstream of Clifton Court Forebay (CCF) and the entrance to Delta-  
12 Mendota Canal (DMC) may also have the most potential to considerably reduce entrainment of  
13 juvenile salmonids and juvenile and adult Sacramento splittail. There is somewhat less potential to  
14 reduce entrainment of juvenile and adult smelts, primarily because of lower escape ability.  
15 Insensitivity of sturgeons and lampreys makes them unlikely to benefit from NPBs. The potential  
16 importance of NPBs is that fish would not be subject to the salvage process, which generally is quite  
17 inefficient. Pre-screen predation in CCF in particular results in the majority of fish not being  
18 salvaged.

19 The physical structures of the NPBs may attract piscivorous fish to the area and increase localized  
20 predation risks. Studies on the NPBs at the head of Old River indicate that the barrier is very  
21 effective at deterring salmon smolts from entering Old River. However, many predators were  
22 attracted and the predation rate was so high that the juvenile salmon survival rate was not  
23 statistically different whether the barrier was on or off.

24 Overall, the effects of NPBs would not be adverse and would be less than significant to slightly  
25 beneficial for Chinook salmon, steelhead, delta smelt, and longfin smelt. The overall effects of NPBs  
26 on Sacramento splittail would not be adverse and would be less than significant.

27 Green sturgeon, white sturgeon, Pacific lamprey, and river lamprey would encounter some NPBs but  
28 they are not deterred by sound and light barriers and would continue to enter the central Delta  
29 where higher predation rates occur. However, sturgeon grow rapidly and have armored external  
30 scales which reduce predation on them. The effect on green sturgeon and white sturgeon would not  
31 be adverse and would be less than significant. Pacific lamprey and river lamprey would experience  
32 some additional predation but it is expected to be low and the effect would not be adverse and  
33 would be less than significant.

### 34 **Illegal Harvest Reduction (CM17)**

35 CM17 *Illegal Harvest Reduction* would be applied to Chinook salmon, steelhead, green sturgeon, and  
36 white sturgeon and are expected to have positive effects on these species numbers so that the effect  
37 would be beneficial. Since this conservation measure is not applied to the other covered and non-  
38 covered fish species it would have no direct effect on them. However, since salmon and steelhead do  
39 prey on the other covered and non-covered fish species, higher numbers of these salmonids would  
40 result in some additional predation. The effect of this additional predation would not be adverse and  
41 would be less than significant because these species only occupy the Delta for short periods, they do  
42 not ingest large numbers of the other covered and non-covered fish species, and they are not the  
43 primary predators of the other covered and non-covered fish species.

1       **Conservation Hatcheries (CM18)**

2       CM18 *Conservation Hatcheries* would establish new and expand existing captive conservation  
3       propagation programs for delta smelt and longfin smelt. The principal purpose of this measure is to  
4       ensure the existence of refugial captive populations for these species thereby minimizing extinction  
5       risk. The population would also provide animals for experimentation to address uncertainties about  
6       their biology. Controlled laboratory experiments can provide important information that would  
7       contribute to better management. The effects would be beneficial for delta smelt and longfin smelt.  
8       There would be no effects on the other covered or non-covered fish species.

9       **Urban Stormwater Treatment (CM19)**

10       CM19 *Urban Stormwater Treatment* would reduce contaminants associated with urban areas  
11       because it provides for the treatment of stormwater discharges. Stormwater treatment would  
12       reduce urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and other  
13       contaminants. These reductions would contribute to improved water quality in the Delta. Based on  
14       the improved overall water quality conditions and reduced pesticides the effect would be beneficial  
15       for all covered and non-covered fish species.

16       **Removal/Relocation of Nonproject Diversions (CM21)**

17       Alternative 1A has the potential to reduce entrainment related to agricultural diversions through  
18       conversion of agricultural lands into tidal habitat. Alternative 1A would restore 25,000 acres of tidal  
19       habitat in the Plan Area in the ELT and 65,000 acres in the LLT. There are more than 2,600  
20       agricultural diversions in the Plan Area. The analysis estimated the removal of approximately 109  
21       diversions by the ELT and approximately 236 by the LLT corresponding to approximately 4.2 and  
22       12.4% of the total number of diversions, respectively. Modeling for delta smelt indicates that  
23       Alternative 1A would reduce overall entrainment of delta smelt larvae from approximately 0.08 to  
24       0.34% in the ELT and from approximately 0.25 to 0.99% in the LLT. Longfin smelt generally exit the  
25       Delta earlier than delta smelt, thereby avoiding exposure to agricultural diversions when they are  
26       operating at capacity. Modeling representing longfin smelt larvae ranged from approximately 0 to  
27       over 10% with generally lower entrainment under Alternative 1A scenarios than baseline scenarios.  
28       For longfin smelt the average decrease in entrainment under Alternative 1A scenarios compared to  
29       baseline scenarios ranged from 2.3 to 3.5%, whereas the average increase under Alternative 1A  
30       scenarios was much less (0.0–0.1%). These effects would be beneficial for both delta smelt and  
31       longfin smelt. The effects on other covered and non-covered fish species would also be beneficial,  
32       although the amount of reduced entrainment for these covered and non-covered fish species is  
33       likely less than for the smelts.

34       **Comparison of Alternative 1A to Alternative 4 (Proposed Project)**

35       Alternative 1A would convey up to 15,000 cfs of water from the north Delta to the south Delta  
36       through pipelines/tunnels via five screened intakes on the east bank of the Sacramento River  
37       between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). While Alternative 4 would also  
38       consist of constructing similar intake and conveyance structures, in this same area of the river, it  
39       would include only three intakes, with a conveyance capacity of up to 9,000 cfs.

40       Operationally, Alternative 1A would follow Scenario A, while Alternative 4 would have different  
41       water conveyance operational criteria (Operational Scenario H), resulting in different patterns of  
42       water withdrawals from the north Delta, and potentially different effects on water quality and

1 aquatic habitat conditions in the Plan Area. As fully described in Chapter 3, *Description of*  
2 *Alternatives*, Alternative 4 operations incorporate a decision tree process that results in four  
3 potential operational sub-scenarios, depending on the outcome of the decision tree process for  
4 spring outflow and Fall X2 operations.

### 5 **Construction and Maintenance of CM1**

6 The potential for construction and maintenance activities to affect the covered fish species would  
7 typically be proportional to the number of north Delta intakes constructed, and the total area of  
8 habitat affected. As a result, Alternative 1A would have a greater potential for effects because it  
9 includes the construction of two additional intakes (five), compared to only three for Alternative 4,  
10 along with the associated increase in dredging to re-contour the adjacent streambed. These  
11 additional intakes would result in a total of about 12.5 acres (77%) more in-water area affected by  
12 construction activities than for Alternative 4. In addition, the total length of shoreline permanently  
13 replaced by the intakes (11,900 feet) would be 87% greater than Alternative 4 (see Table 11-1A-  
14 SUM1). In addition to the effects of intake construction, Alternative 1A would require about 60%  
15 more (10.2 acres) of dredging to re-contour the streambed, offshore of the intake structure.  
16 However, both alternatives include a conveyance tunnel, and six barge landings to support tunnel  
17 construction. Each barge landing would include in-water and over-water structures, occupying  
18 approximately 15,000 square feet of nearshore habitat.

19 As discussed above, adverse effects would be effectively avoided and minimized by implementing  
20 environmental commitments and BMPs (see Appendix 3B, *Environmental Commitments*). These  
21 include pile driving minimization measures AQUA-1a and AQUA-1b, as well as isolating much of the  
22 in-water work inside cofferdams, constructing in areas that have limited use by the covered species,  
23 adhering to the approved in-water work windows, and activity-specific timing restrictions. While  
24 small numbers of covered fish species may be affected by construction activities, the effects would  
25 not limit overall population productivity.

26 In summary, construction and maintenance activities would result in limited temporary and  
27 permanent effects on the covered fish species and their habitat. While these effects would vary by  
28 species and species life stages, the implementation of environmental commitments and BMPs (see  
29 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
30 not adverse and less than significant. The implementation of habitat restoration activities,  
31 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
32 the intake sites.

### 33 **Water Operations of CM1**

34 Water operations under Alternative 1A differ from Alternative 4 in a few ways. Alternative 1A  
35 utilizes five intakes in the north Delta that can convey up to 15,000 cfs while Alternative 4 utilizes  
36 three intakes and can only convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*, average  
37 annual exports under Alternative 1A are anticipated to be 5,456 TAF while Alternative 4 has  
38 anticipated exports ranging from 4,414 (under H4) to 5,255 (under H1). Average annual outflows  
39 would typically be greater for the Alternative 4 operational scenarios than Alternative 1A (between  
40 208 and 1,067 TAF greater). However, Alternative 1A would result in less annual average outflow  
41 than Existing Conditions (about 323 TAF less) and NAA (1,072 TAF less).

42 There are various benefits to entrainment and migration for some species under both alternatives,  
43 while Alternative 4 provides potentially greater beneficial effects on rearing conditions for Delta

1 smelt, and lower potential for effects on longfin smelt rearing and migration, and green and white  
2 sturgeon migration.

### 3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 1A would be the same as Alternative 4.  
5 Consequently, the effects of these measures would also be the same.

### 6 **Other Conservation Measures (CM12–CM19 and CM21)**

7 With respect to other conservation measures, Alternative 1A would be the same as Alternative 4.  
8 Consequently, the effects associated with these other conservation measures would also be the same  
9 for both alternatives.

## 10 **11.0.2.2 Alternative 1B—Summary of Effects**

### 11 **Overview**

12 Alternative 1B would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water  
13 routed from the north Delta to the south Delta would be conveyed by gravity through a canal along  
14 the east side of the Delta instead of through pipelines/tunnels. While the five intakes would be  
15 located and constructed on the east bank of the Sacramento River identical to those under  
16 Alternative 1A, the difference in the type of conveyance facility (e.g., canal) results in different  
17 construction details to a limited extent as they relate to potential impacts on fish. Specifically, eight  
18 culvert and three tunnel siphons would be utilized to divert canal water beneath existing water  
19 courses and their construction would occur within those water courses. Alternative 1B would also  
20 have one barge landing and 19 bridge crossings compared to six barge landings and no bridge  
21 crossings for Alternative 1A. Approximately 4,500 barge trips would occur during construction.  
22 Besides the primary difference of utilizing a canal rather than a tunnel, Alternative 1B would have  
23 other structural differences such as inclusion of an intermediate pumping plant and elimination of  
24 the intermediate forebay. However, these latter differences would not affect fish resources and are  
25 not evaluated further in this chapter. Overall, construction impacts from Alternative 1B would be  
26 similar to Alternative 1A but with additional in-water work.

27 Water supply and conveyance operations would follow the guidelines described as Scenario A,  
28 which is identical to those analyzed under Alternative 1A.

29 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
30 these CMs would be identical to those under Alternative 1A.

### 31 **Construction and Maintenance of CM1**

32 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
33 affect the covered fish species would typically be proportional to the number of north Delta intakes  
34 constructed, and the total area of habitat affected. Alternative 1B includes the same five intakes as  
35 Alternative 1A, so the area affected by intake construction would be the same (see Table 11-1A-  
36 SUM1). Although Alternative 1B includes a conveyance canal instead of a tunnel, and only one barge  
37 landing instead of the six needed for Alternative 1A, most of the in-water construction activities  
38 would be the same.

1 Similar to Alternative 1A, between 1.2 and 6.9 acres of river area would be isolated behind  
2 cofferdams, and temporarily or permanently lost at each Alternative 1B intake, for a maximum  
3 estimated total of 28.7 acres. During the in-water construction period, a total of up to about 27.3  
4 acres of in-water habitat would be affected by dredging activities, resulting in the loss or alteration  
5 of low-quality spawning, rearing, and migration habitat for covered fish species (see Table 11-1A-  
6 SUM1). Likewise, the footprint of the intake and transition wall structures would result in  
7 permanent loss of about 11,900 feet of primarily steep-banked and riprapped shoreline habitat. The  
8 barge landing would include in-water and over-water structures, occupying approximately 15,000  
9 square feet of shoreline habitat, although this would be 83% lower than for Alternative 1A.

10 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
11 potential to cause adverse effects on covered species, although these adverse effects would be  
12 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
13 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
14 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
15 constructing in areas that have limited use by the covered species, adhering to the approved in-  
16 water work windows, and activity-specific timing restrictions.

17 While in-water construction activities would temporarily or permanently alter habitat conditions in  
18 the construction vicinity, the extent of the overall available habitat affected, and the relatively poor  
19 quality of the affected habitat, is expected to limit the effects of construction and maintenance  
20 activities on most covered fish species. While individual fish may be affected by construction  
21 activities, the effects would not limit overall population productivity.

22 In summary, construction and maintenance activities would result in limited temporary and  
23 permanent effects on the covered fish species or their habitat. While these effects would vary by  
24 species and species life stages, the implementation of environmental commitments and BMPs (see  
25 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
26 not adverse and less than significant. In addition, the implementation of Mitigation Measures  
27 Mitigation Measures AQUA-1a and AQUA 1b would reduce the severity of pile driving noise effects  
28 on all the covered species, to be not adverse and less than significant. The implementation of habitat  
29 restoration activities, particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat  
30 loss or alteration at the intake sites.

### 31 **Water Operations of CM1**

32 With respect to water operations of CM1, Alternative 1B is the same as Alternative 1A.  
33 Consequently, all the effects associated with water operations of CM1 under Alternative 1B are the  
34 same as those described above under the Alternative 1A summary.

### 35 **Restoration Measures (CM2, CM4–CM7, and CM10)**

36 With respect to restoration measures, Alternative 1B is the same as Alternative 1A. Consequently, all  
37 the effects associated with restoration measures under Alternative 1B are the same as those  
38 described above under the Alternative 1A summary.

### 39 **Other Conservation Measures (CM12–CM19 and CM21)**

40 With respect to other conservation measures, Alternative 1B is the same as Alternative 1A.  
41 Consequently, all the effects associated with other conservation measures under Alternative 1B are  
42 the same as those described above under the Alternative 1A summary.

## 1       **Comparison of Alternative 1B to Alternative 4 (Proposed Project)**

2       Alternative 1B would divert up to 15,000 cfs of water from the north Delta via five screened intakes  
3       on the east bank of the Sacramento River between Clarksburg and Walnut Grove (i.e., Intakes 1  
4       through 5). This water would be conveyed to the south Delta through an eastern diversion canal  
5       alignment, with invert culvert siphons needed to cross seven streams/sloughs along the route.  
6       While Alternative 4 would consist of constructing similar intakes structures, in this same area of the  
7       river, it would include only three intakes, with a conveyance tunnel/pipeline with a capacity of up to  
8       9,000 cfs. While the Alternative 4 tunnel/pipeline structure would not require any culvert siphons, it  
9       would require five more barge landings (six total) to support the construction process, compared to  
10      Alternative 1B (one landing).

11      Alternative 1B would follow the same operational scenario as Alternative 1A (Operational Scenario  
12      A), while Alternative 4 would follow Operational Scenario H, resulting in different patterns of water  
13      withdrawals from the north Delta, and potentially different effects on water quality and aquatic  
14      habitat conditions in the Plan Area. As fully described in Chapter 3, *Description of Alternatives*,  
15      Alternative 4 operations incorporate a decision tree process that results in four potential  
16      operational sub-scenarios, depending on the outcome of the decision tree process for spring outflow  
17      and Fall X2 operations.

## 18      **Construction and Maintenance of CM1**

19      The potential for construction and maintenance activities to affect the covered fish species would  
20      typically be proportional to the number of north Delta intakes constructed, and the total area of  
21      habitat affected. As a result, Alternative 1B would have substantially greater potential for effects  
22      than Alternative 4, because it includes the construction of two additional intakes (five total). The  
23      additional intakes would also require additional dredging to re-contour the adjacent streambed.  
24      These effects would be the same as those described above for Alternative 1A (see Table 11-1A-  
25      SUM1).

26      In addition to the increased intake construction activities for Alternative 1B, the construction of  
27      seven invert culvert siphons to cross streams and sloughs along the conveyance canal route would  
28      require additional in-water construction work. These siphons could result in up to about 8 acres of  
29      additional in-water disturbance, compared to Alternative 4, which would tunnel under the water  
30      crossings without requiring in-water work at these crossings. In contrast to the additional in-water  
31      construction activities for the intakes and canal facilities, Alternative 1B would require five fewer  
32      barge landings to support construction, each with over-water structures occupying approximately  
33      15,000 square feet of area.

34      As discussed above, adverse effects would be effectively avoided and minimized by implementing  
35      environmental commitments and BMPs (see Appendix 3B, *Environmental Commitments*). These  
36      include pile driving minimization measures AQUA-1a and AQUA-1b, as well as isolating much of the  
37      in-water work inside cofferdams, constructing in areas that have limited use by the covered species,  
38      adhering to the approved in-water work windows, and activity-specific timing restrictions. While  
39      individual fish may be affected by construction activities, the effects would not limit overall  
40      population productivity.

41      In summary, construction and maintenance activities would result in limited temporary and  
42      permanent effects on the covered fish species and their habitat. While these effects would vary by  
43      species and species life stages, the implementation of the environmental commitments, described

1 above, would reduce most of these construction effects to be not adverse and less than significant.  
2 The implementation of habitat restoration activities, particularly CM6 *Channel Margin Enhancement*,  
3 would offset effects of habitat loss or alteration at the intake sites.

#### 4 **Water Operations of CM1**

5 With respect to water operations, Alternative 1B would be the same as Alternative 1A. Please refer  
6 to the comparison of Alternative 1A to Alternative 4.

#### 7 **Restoration Measures (CM2, CM4–CM7, and CM10)**

8 With respect to restoration measures, Alternative 1B would be the same as Alternative 4.  
9 Consequently, the effects of these measures would also be the same.

#### 10 **Other Conservation Measures (CM12–CM19 and CM21)**

11 With respect to other conservation measures, Alternative 1B would be the same as Alternative 4.  
12 Consequently, the effects associated with these other conservation measures would also be the same  
13 for both alternatives.

### 14 **11.0.2.3 Alternative 1C—Summary of Effects**

#### 15 **Overview**

16 Alternative 1C would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water  
17 routed from the north Delta to the south Delta would be conveyed by gravity through a canal along  
18 the west side of the Delta instead of through pipelines/tunnels. This is similar to Alternative 1B,  
19 except that Alternative 1B utilizes canal conveyance on the east side of the Delta. Under Alternative  
20 1C, the five intakes would be constructed on the west side of the Sacramento River rather than the  
21 east side as under Alternative 1A and Alternative 1B. Similar to Alternative 1B, while there would be  
22 the same types and number of intakes, the difference in the type of conveyance facility (e.g., canal)  
23 results in different construction details to a limited extent as they relate to potential impacts on fish.  
24 Specifically, nine culvert and no tunnel siphons would be utilized to divert canal water beneath  
25 existing water courses and their construction would occur within those water courses. Alternative  
26 1C would also have two barge landings and 16 bridge crossings compared to six barge landings and  
27 no bridge crossings for Alternative 1A and one barge landing and 19 bridge crossings for Alternative  
28 1B. Approximately 3,000 barge trips would occur during construction. Besides the primary  
29 difference of utilizing a canal rather than a tunnel, Alternative 1C would have other structural  
30 differences such as inclusion of an intermediate pumping plant and elimination of the intermediate  
31 forebay. However, these latter differences would not affect fish resources. Overall, construction  
32 impacts from Alternative 1C would be similar to Alternative 1A but with additional in-water work.

33 Water supply and conveyance operations would follow the guidelines described as Operational  
34 Scenario A, which is identical to those analyzed under Alternative 1A.

35 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
36 these CMs would be identical to those under Alternative 1A.

## 1 **Construction and Maintenance of CM1**

2 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
3 affect the covered fish species would typically be proportional to the number of north Delta intakes  
4 constructed, and the total area of habitat affected. While Alternative 1C includes the same number of  
5 intakes (five) as Alternative 1A, they would be constructed on the opposite (west) shoreline of the  
6 Sacramento River, and the total area affected by intake construction would be about 14% greater  
7 than Alternative 1A (see Table 11-1A-SUM1). Although Alternative 1C includes a conveyance canal  
8 instead of a tunnel, and only two barge landings instead of the six needed for Alternative 1A, most of  
9 the in-water construction activities would be similar. Alternative 1C also includes 16 bridge crossing  
10 structures for the conveyance canal, compared to no bridge structures for Alternative 1A, although  
11 these structures are expected to include limited in-water construction activities.

12 At each Alternative 1C intake, between 1.4 and 7.8 acres of river area would be isolated behind  
13 cofferdams, and temporarily or permanently lost, for an estimated total of 32.7 acres. This would be  
14 slightly greater than for Alternative 1A. During the in-water construction period, a total of up to  
15 about 20.3 acres of low-quality spawning, rearing, and migration habitat for covered fish species  
16 would be affected by dredging activities. This is about 26% less loss or alteration than Alternative  
17 1A (see Table 11-1A-SUM1). Likewise, the footprint of the intake and transition wall structures  
18 would result in permanent loss of about 10,100 feet of primarily steep-banked and riprapped  
19 shoreline habitat, or about 15% less than Alternative 1A. The two barge landings would include in-  
20 water and over-water structures, occupying approximately 15,000 square feet of shoreline habitat  
21 each, although this would be 67% less than for Alternative 1A.

22 While in-water construction activities would temporarily or permanently alter habitat conditions in  
23 the construction vicinity, the extent of the overall available habitat affected, and the relatively poor  
24 quality of the affected habitat, is expected to limit the effects of construction and maintenance  
25 activities on most covered fish species. Thus the effects would not measurably reduce potential  
26 population productivity.

27 In summary, construction and maintenance activities would result in limited temporary and  
28 permanent effects on the covered fish species or their habitat. While these effects would vary by  
29 species and species life stages, the implementation of environmental commitments and BMPs (see  
30 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
31 not adverse and less than significant. In addition, the implementation of Mitigation Measures  
32 Mitigation Measures AQUA-1a and AQUA 1b would reduce the severity of pile driving noise effects  
33 on all the covered species, to be not adverse and less than significant. The implementation of habitat  
34 restoration activities, particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat  
35 loss or alteration at the intake sites.

## 36 **Water Operations of CM1**

37 With respect to water operations of CM1, Alternative 1C is the same as Alternative 1A. Consequently,  
38 all the effects associated with water operations of CM1 under Alternative 1C are the same as those  
39 described above under the Alternative 1A summary.

1       **Restoration Measures (CM2, CM4–CM7, and CM10)**

2       With respect to restoration measures, Alternative 1C is the same as Alternative 1A. Consequently, all  
3       the effects associated with restoration measures under Alternative 1C are the same as those  
4       described above under the Alternative 1A summary.

5       **Other Conservation Measures (CM12–CM19 and CM21)**

6       With respect to other conservation measures, Alternative 1C is the same as Alternative 1A.  
7       Consequently, all the effects associated with other conservation measures under Alternative 1C are  
8       the same as those described above under the Alternative 1A summary.

9       **Comparison of Alternative 1C to Alternative 4 (Proposed Project)**

10       Alternative 1C would convey up to 15,000 cfs of water from the north Delta to the south Delta  
11       through a surface canal on the west side of the Sacramento River, from five screened intakes  
12       constructed between Clarksburg and Walnut Grove (i.e., Intakes 1W through 5W). While Alternative  
13       4 would construct similar intake facilities in this same portion of the river, it would include only  
14       three intakes (9,000 cfs combined capacity), and these intakes would be on the east side of the river.  
15       While Alternative 4 would tunnel under a number of waterways along the conveyance route, the  
16       surface canal for Alternative 1C would use culvert siphons to pass under nine waterways, requiring  
17       in-water construction. Alternative 1C would also have two barge landings and 16 bridge crossings  
18       along the canal route, compared to six barge landings and no bridge crossings for Alternative 4.

19       Alternative 1C would follow the same operational scenario as Alternative 1A (Operational Scenario  
20       A), while Alternative 4 would follow Operational Scenario H, resulting in different patterns of water  
21       withdrawals from the north Delta, and potentially different effects on water quality and aquatic  
22       habitat conditions in the Plan Area. As fully described in Chapter 3, *Description of Alternatives*,  
23       Alternative 4 operations incorporate a decision tree process that results in four potential  
24       operational sub-scenarios, depending on the outcome of the decision tree process for spring outflow  
25       and Fall X2 operations.

26       **Construction and Maintenance of CM1**

27       The potential for construction and maintenance activities to affect the covered fish species would  
28       typically be proportional to the number of north Delta intakes constructed, and the total area of  
29       habitat affected. As a result, Alternative 1C would have substantially greater potential for effects  
30       than Alternative 4, because it includes the construction of two additional intakes (five total). The  
31       additional intakes would also require about 17% more (3 acres) dredging to re-contour the adjacent  
32       streambed, compared to Alternative 4. The effects would be the similar to those described above for  
33       Alternative 1A (see Table 11-1A-SUM1).

34       In addition to the increased intake construction effects for Alternative 1C, the construction of nine  
35       invert culvert siphons for the water conveyance canal to cross stream and sloughs would have  
36       additional in-water effects. These siphons could result in up to about 6 acres of additional in-water  
37       disturbance, compared to Alternative 4, which would tunnel under the water crossings without  
38       requiring in-water work. In contrast to the additional in-water construction activities for the intakes  
39       and canal facilities, Alternative 1C would require four fewer barge landings than Alternative 4, each  
40       with over-water structures occupying approximately 15,000 square feet of area.

1 As discussed above, in-water and nearshore construction activities have the potential to cause  
 2 adverse effects on covered species, although these adverse effects would be effectively avoided and  
 3 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
 4 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
 5 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
 6 that have limited use by the covered species, adhering to the approved in-water work windows, and  
 7 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
 8 the effects would not limit overall population productivity.

9 In summary, construction and maintenance activities would result in limited temporary and  
 10 permanent effects on the covered fish species and their habitat. While these effects would vary by  
 11 species and species life stages, the implementation of the environmental commitments, described  
 12 above, would reduce most of these construction effects to be not adverse and less than significant.  
 13 The implementation of habitat restoration activities, particularly CM6 *Channel Margin Enhancement*,  
 14 would offset effects of habitat loss or alteration at the intake sites.

#### 15 **Water Operations of CM1**

16 With respect to water operations, Alternative 1C would be the same as Alternative 1A. Please refer  
 17 to the comparison of Alternative 1A to Alternative 4.

#### 18 **Restoration Measures (CM2, CM4–CM7, and CM10)**

19 With respect to restoration measures, Alternative 1C would be the same as Alternative 4.  
 20 Consequently, the effects of these measures would also be the same.

#### 21 **Other Conservation Measures (CM12–CM19 and CM21)**

22 With respect to other conservation measures, Alternative 1C would be the same as Alternative 4.  
 23 Consequently, the effects associated with these other conservation measures would also be the same  
 24 for both alternatives.

### 25 **11.0.2.4 Alternative 2A—Summary of Effects**

#### 26 **Overview**

27 Like Alternative 1A, Alternative 2A would consist of pipelines and tunnels generally located in the  
 28 central Delta with an intermediate forebay; however, Alternative 2A could potentially entail two  
 29 different intake and intake pumping plant locations. Currently, as an alternative to Intakes 1–5,  
 30 intake locations 1, 2, 3, 6, and 7 are being considered. Selection of intake locations 6 and 7 would  
 31 entail construction in the same region (north Delta) and would result in the same construction  
 32 effects on fish species as discussed for Alternative 1A. In addition, some of the conveyance pipelines  
 33 and the initial tunnel (Tunnel 1) between the intake pumping plants and the intermediate forebay  
 34 would be adjusted depending on the intake locations. This alternative would convey water from five  
 35 fish-screened intakes between Clarksburg and Walnut Grove (Intakes 6 and 7, if selected, would be  
 36 downstream of Sutter and Steamboat Sloughs) to an intermediate forebay near the intakes, and then  
 37 to a new Byron Tract Forebay adjacent to CCF. Construction effects for all fish species would be  
 38 similar to those described for Alternative 1A.

39 Alternative 2A water conveyance operational criteria (Operational Scenario B) would be modified  
 40 from those described for Alternative 1A. Like Alternative 1A, the Alternative 2A facilities could

1 convey up to 15,000 cfs from the north Delta. Operational Scenario B includes incorporation of Fall  
 2 X2 guidelines and more restrictive south Delta OMR flows, as described in Section 3.6.4.2, *North*  
 3 *Delta and South Delta Water Conveyance Operational Criteria*. Operational Scenario B also includes  
 4 north Delta diversion bypass flow criteria, flow criteria over Fremont Weir into Yolo Bypass, Delta  
 5 inflow and outflow criteria, DCC gate operations, Rio Vista minimum instream flow criteria,  
 6 operations for Delta water quality and residence criteria, and water quality criteria for agricultural  
 7 and municipal/industrial diversions but would not include the San Joaquin River inflow/export  
 8 ratio.

9 While the locations of the north Delta intakes could be different under this alternative than under  
 10 Alternative 1A, the overall effects on fish are not expected to be measurably different, because of the  
 11 distance between locations is small relative to the overall areas affected by operations under the  
 12 alternative. CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this  
 13 alternative, and these CMs would be identical to those under Alternative 1A.

#### 14 **Construction and Maintenance of CM1**

15 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
 16 affect the covered fish species would typically be proportional to the number of north Delta intakes  
 17 constructed, and the total area of habitat affected. Alternative 2A includes the same number of  
 18 intakes (five) as Alternative 1A, and potentially the same intake locations. Therefore, the total area  
 19 affected by intake construction would also be similar (see Table 11-1A-SUM1). Like Alternative 1A,  
 20 Alternative 2A also includes a conveyance tunnel, and six barge landings, such that most of the in-  
 21 water construction activities would be the same.

22 At each Alternative 2A intake, between 1.2 and 6.9 acres of river habitat would be isolated behind  
 23 cofferdams, and temporarily or permanently lost, for an estimated maximum total of between 27.1  
 24 and 28.7 acres. During the in-water construction period, a total of up to about 26.0 acres of in-water  
 25 habitat would be affected by dredging activities, resulting in slightly less loss or alteration of low-  
 26 quality spawning, rearing, and migration habitat for covered fish species as Alternative 1A (see  
 27 Table 11-1A-SUM1). Likewise, the footprint of the intake and transition wall structures would result  
 28 in permanent loss of between 11,350 and 11,900 feet of primarily steep-banked and riprapped  
 29 shoreline habitat. The six barge landings would include in-water and over-water structures,  
 30 occupying approximately 15,000 square feet of shoreline habitat each.

31 While in-water construction activities would temporarily or permanently alter habitat conditions in  
 32 the construction vicinity, the extent of the overall available habitat affected, and the relatively poor  
 33 quality of the affected habitat, is expected to limit the effects of construction and maintenance  
 34 activities on most covered fish species. Thus the effects would not measurably reduce potential  
 35 population productivity.

36 In summary, construction and maintenance activities would result in limited temporary and  
 37 permanent effects on the covered fish species or their habitat. While these effects would vary by  
 38 species and species life stages, the implementation of environmental commitments and BMPs (see  
 39 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
 40 not adverse and less than significant. In addition, the implementation of Mitigation Measures  
 41 Mitigation Measures AQUA-1a and AQUA 1b would reduce the severity of pile driving noise effects  
 42 on all the covered species, to be not adverse and less than significant. The implementation of habitat  
 43 restoration activities, particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat  
 44 loss or alteration at the intake sites.

## 1 **Water Operations of CM1**

2 The methods and analysis of Alternative 2A are the same as those previously described for  
 3 Alternative 1A. However, Alternative 2A includes five intakes (1, 2, 3, 6, and 7) two of which are  
 4 different than Alternative 1A (i.e., 6 and 7 rather than 4 and 5) and Alternative 2A uses water  
 5 Operational Scenario B. The sizes of the conveyance infrastructures are similar while the water  
 6 operations scenario differs with more restrictive OMR flow limits and an operational barrier at the  
 7 head of Old River.

## 8 ***Changes in Exports and Outflow***

9 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
 10 Alternative 2A are anticipated to decrease slightly by 76 TAF relative to Existing Conditions, and  
 11 increase by 627 TAF relative to the No Action Alternative. Over the long-term, approximately 58% of  
 12 the exported water will be from the new north Delta intakes, and average monthly diversions at the  
 13 south Delta intakes would correspondingly decrease. These changes would increase the proportion  
 14 of San Joaquin River water flowing throughout the south, west, and interior Delta, and a  
 15 corresponding decrease in the proportion of Sacramento River water.

16 Under Alternative 2A, long-term average annual Delta outflow is anticipated to increase 105 TAF  
 17 relative to Existing Conditions and would decrease by 645 TAF relative to the NAA. It is important to  
 18 note that some outflow changes under Alternative 2A are greater relative to Existing Conditions  
 19 because Existing Conditions do not include operations to meet Fall X2, whereas NAA and  
 20 Alternative 2A do include Fall X2.

21 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
 22 diverted in August through mid-December and less water diverted mid-December through July),  
 23 there would be beneficial, not adverse/less than significant, and adverse/significant and  
 24 unavoidable effects/impacts on fish under Alternative 2A. Following is a summary of these effects as  
 25 they relate to the key factors of entrainment and flow, which in turn affects fish survival and  
 26 spawning, rearing, and migration habitat conditions.

## 27 ***Entrainment***

28 Similar to Alternative 1A, overall entrainment of numerous species under Alternative 2A would be  
 29 less than or similar to the levels experienced in the recent years. This is because the north Delta  
 30 diversion operations would reduce reliance on south Delta export facilities (greater entrainment  
 31 rates are expected to occur at south Delta facilities), along with additional minor benefits from  
 32 decommissioning of agricultural diversions in restoration areas and implementation of an  
 33 alternative intake for the North Bay Aqueduct. Additionally, the slightly reduced exports under  
 34 Alternative 2A as compared to 1A provide further reductions in entrainment, resulting in some  
 35 beneficial effects for delta smelt, longfin smelt, and some Chinook salmon.

36 Similar to Alternative 1A reduced entrainment of juvenile salmonids would occur primarily under  
 37 the wetter conditions with little change under drier conditions.

38 Finally, Alternative 2A is expected to reduce Pacific and river lamprey entrainment due to  
 39 reductions in south Delta exports and decommissioning agricultural diversions to an extent similar  
 40 to Alternative 1A.

1 Since the proposed north Delta intakes under Alternative 2A are the same design as those proposed  
2 under Alternative 1A, the potential to affect some fish species through contact with the screens  
3 and/or increased predation around those facilities still exists at the same level as Alternative 1A.  
4 Regardless, these effects are considered to be not adverse.

5 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
6 in the Delta. There are very few instances where there would be increases, but these are  
7 substantially offset by decreases during other periods. Effects are at a minimum not adverse and less  
8 than significant, with effects being beneficial for many species.

### 9 **Flows**

10 While San Joaquin River flows are not expected to be directly affected by Alternative 2A, flow  
11 changes are expected in the Sacramento River and its tributaries, as well as within the Sacramento-  
12 San Joaquin Delta. Changes in flow will result from changes in releases from upstream reservoirs,  
13 diversions from the south Delta, and reductions in flows downstream of the proposed north Delta  
14 intakes. Also, more restrictive OMR flow limits and an operable barrier at the head of Old River will  
15 improve flow conditions in the south Delta.

16 The area of fall abiotic habitat for juvenile delta smelt in the open-water areas of the Suisun Bay,  
17 Suisun Marsh, and west Delta subregions would be larger under Alternative 2A than under NAA  
18 conditions. In contrast to Alternative 1A, this area would increase even more relative to Existing  
19 Conditions without the Fall X2 flows. The increase in fall abiotic habitat area in the open estuary is  
20 further enhanced by tidal marsh habitat restoration, when considered across all water year types,  
21 relative to both Existing Conditions and NAA. Assuming the expected benefits of habitat restoration  
22 are realized, the relative increase in abiotic habitat index would be at least 25% for all years  
23 combined, if not, there would be only minor changes in abiotic habitat index. Therefore, the overall  
24 effects on delta smelt are uncertain, until potential habitat restoration benefits are assessed.  
25 However, Alternative 2 may decrease sediment supply to the estuary by 8 to 9 percent, with the  
26 potential for decreased habitat suitability for delta smelt in some locations. In contrast, migration  
27 conditions are not expected to substantially change.

28 Decreased spring outflows under Alternative 2A have the potential to contribute to modest  
29 decreases in longfin smelt abundance from reduced larval transport flows and spring habitat  
30 quantity and quality for larval and early juvenile longfin smelt in the Suisun Marsh and west Delta  
31 subregions. However, habitat restoration could provide benefits through additional food production  
32 and export to longfin smelt rearing areas in Suisun Marsh, West Delta, and Cache Slough ROAs.  
33 Alternative 2A operations would be expected to result in 5–6% lower longfin smelt abundance  
34 compared to NAA, for all years combined.

35 With regard to salmonids, several issues were identified as described below with some of them  
36 resulting in adverse and/or significant effects. For example, Sacramento River attraction flows for  
37 migrating adult salmonids would be lower from operations of the north Delta diversions under  
38 Alternative 2A, but not to an adverse level. However, winter-run Chinook salmon would be  
39 adversely affected by an estimated 31% reduction in years with good spawning habitat availability,  
40 and a 45% decrease in the years with good juvenile stranding risks. Similarly, migration conditions  
41 for spring-run and fall-run/late fall-run Chinook salmon would be adversely affected as a result of  
42 reduced flows in the Feather River. Despite implementation of conservation and mitigation  
43 measures, which would reduce the severity of effects, these effects are likely to remain significant  
44 and unavoidable. While spring-run Chinook salmon rearing conditions would be affected to some

1 degree, the overall effects cannot be determined with available modeling information, and  
2 additional modeling will be conducted to verify that an adverse effect is unlikely to occur. Steelhead  
3 would be adversely affected for several parameters under Alternative 2A. Compared to Existing  
4 Conditions, the quantity and quality of rearing and migration habitat would be substantially reduced  
5 due to decreases in flow and water temperatures elevated. Despite these significant and unavoidable  
6 effects, proposed adaptive management mitigation has the potential to reduce the severity of  
7 impacts to the salmonid species though not necessarily to a less than significant level.

8 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
9 the Yolo Bypass provide substantial benefits to Sacramento splittail, primarily with regard to  
10 spawning and migration.

11 Alternative 2A would result in similar effects for green and white sturgeon as those described above  
12 for salmonids with respect to lower flows in the Feather River. Green sturgeon spawning, rearing,  
13 and migration habitat would be adversely affected. White sturgeon spawning and migration habitat  
14 would also be affected by reduced April and May Delta outflow, which has been correlated with  
15 reduced year class strength in some water year types. However, this relationship was reached in the  
16 absence of north Delta intakes and the exact mechanism that causes this correlation is not known at  
17 this time. This uncertainty would be addressed through targeted research and monitoring to be  
18 conducted in the years leading up to the initiation of north Delta facilities operations. These targeted  
19 investigations are expected to identify the primary mechanisms that drive sturgeon year-class  
20 strength, and the final determination of the overall effects of Alternative 2A relative to NAA.

21 Alternative 2A would not adversely affect spawning and egg incubation habitat for lamprey species,  
22 despite increased water temperatures on the Feather River and increased redd dewatering in the  
23 Sacramento and American rivers. Flow reductions on several waterways, including the Sacramento,  
24 Trinity, and American rivers, when compared to Existing Conditions, could affect lamprey rearing  
25 and migration habitat, although the differences would also not be significant or adverse.

26 As evidenced by this summary, some changes in flow under Alternative 2A are adverse to fish  
27 species. These flow changes are the result of upstream operational effects and would be largely  
28 independent of the range in locations for the five north Delta intakes under Alternative 2A.  
29 Alternative 2A also includes the same conservation measures as Alternative 1A, with habitat  
30 restoration that provide substantial habitat improvements for fish. When the flow and habitat  
31 restoration measures are considered together, many of the effects of Alternative 2A measures are  
32 beneficial or not adverse and/or less than significant. However, several effects resulting from  
33 changes in flows upstream of the Delta remain adverse and/or significant and unavoidable,  
34 particularly with regard to migration conditions for a number of covered fish species. Summary  
35 Table 11-2A-SUM1 presents the results of the flow related effects on fish.

1 **Table 11-2A-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	NA/LTS	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	B/B		ND/LTS (combined)	
Winter-Run Chinook salmon	B/B	A/SU	A/SU	A/SU
Spring-Run Chinook salmon	NA/LTS	ND/LTS	NA/LTS	A/SU
Fall-Run/Late Fall-Run Chinook salmon	NA/B	NA/LTS	NA/LTS	A/SU
Steelhead	NA/LTS	NA/LTS	A/SU	A/SU
Sacramento splittail	NA/LTS	NA/LTS	B/B	NA/LTS
Green sturgeon	NA/LTS	NA/LTS	NA/LTS	A/SU
White sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 2A is the same as Alternative 1A. Consequently, all  
5 the effects associated with restoration measures under Alternative 2A are the same as those  
6 described above under the Alternative 1A summary.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 With respect to other conservation measures, Alternative 2A is the same as Alternative 1A.  
9 Consequently, all the effects associated with other conservation measures under Alternative 2A are  
10 the same as those described above under the Alternative 1A summary.

11 **Comparison of Alternative 2A to Alternative 4 (Proposed Project)**

12 Alternative 2A would convey up to 15,000 cfs of water from five north Delta screened intakes on the  
13 east bank of the Sacramento River between Clarksburg and Walnut Grove, and pipeline/tunnel  
14 conveyance facilities to the south Delta. While Alternative 4 would construct similar intake and  
15 conveyance structures in this same area of the river, it would include only three intakes and a  
16 conveyance structure with a lower total capacity of 9,000 cfs.

17 Alternative 2A would follow Operational Scenario B, while Alternative 4 would follow Operational  
18 Scenario H, resulting in different patterns of water withdrawals from the north Delta, and  
19 potentially different effects on water quality and aquatic habitat conditions in the Plan Area. As fully  
20 described in Chapter 3, *Description of Alternatives*, Alternative 4 operations incorporate a decision  
21 tree process that results in four potential operational sub-scenarios, depending on the outcome of  
22 the decision tree process for spring outflow and Fall X2 operations.

## 1 **Construction and Maintenance of CM1**

2 The potential for construction and maintenance activities to affect the covered fish species would  
3 typically be proportional to the number of north Delta intakes constructed, and the total area of  
4 habitat affected. As a result, Alternative 2A would have a greater potential for effects because it  
5 includes the construction of two additional intakes (five), compared to only three for Alternative 4.  
6 These additional intakes would result in a total of up to about 12.5 acres (77%) more in-water area  
7 affected by construction activities than for Alternative 4. In addition, the total length of shoreline  
8 permanently replaced by the intakes (up to about 11,900 feet) would be 87% greater than  
9 Alternative 4 (see Table 11-1A-SUM1). In addition to the effects of intake construction, Alternative  
10 2A would require about 52% more (8.9 acres) of dredging to re-contour the streambed, offshore of  
11 the intake structure. However, both alternatives include a tunnel/pipeline conveyance system, and  
12 six barge landings to support tunnel construction. Each barge landing would include in-water and  
13 over-water structures, occupying approximately 15,000 square feet of nearshore habitat.

14 As discussed above, in-water and nearshore construction activities have the potential to cause  
15 adverse effects on covered species, although these adverse effects would be effectively avoided and  
16 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
17 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
18 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
19 that have limited use by the covered species, adhering to the approved in-water work windows, and  
20 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
21 the effects would not limit overall population productivity.

22 In summary, construction and maintenance activities would result in limited temporary and  
23 permanent effects on the covered fish species and their habitat. While these effects would vary by  
24 species and species life stages, the implementation of environmental commitments and BMPs (see  
25 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
26 not adverse and less than significant. The implementation of habitat restoration activities,  
27 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
28 the intake sites.

## 29 **Water Operations of CM1**

30 Water operations under Alternative 2A differ from Alternative 4 in several ways. Alternative 2A  
31 includes five intakes in the north Delta to convey up to 15,000 cfs, while Alternative 4 utilizes three  
32 intakes, and can only convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*, average  
33 annual exports under Alternative 2A are anticipated to be 5,068 TAF, while Alternative 4 has  
34 anticipated exports ranging from 4,414 (under H4) to 5,255 (under H1). Changes in anticipated  
35 long-term average annual Delta outflow under Alternative 4 also vary between the operational  
36 scenarios (H1-H4). While the average annual outflows would typically be greater for the Alternative  
37 4 operational scenarios than Alternative 2A (between 129 and 639 TAF greater), operational  
38 scenario H1 would result in about 220 TAF lower average annual outflow. Alternative 2A would also  
39 result in greater annual average outflow (about 105 TAF) than Existing Conditions, but about 644  
40 TAF less than NAA.

41 There are various benefits to entrainment and rearing for some species under both alternatives. The  
42 substantive difference is that Alternative 2A results in adverse effects/significant and unavoidable  
43 impacts on spawning, rearing and migration of winter-run Chinook salmon; migration conditions for

1 spring-run and fall-/late fall-run Chinook salmon; rearing and migration for steelhead; and  
2 migration for green sturgeon.

### 3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 2A would be the same as Alternative 4.  
5 Consequently, the effects of these measures would also be the same.

### 6 **Other Conservation Measures (CM12–CM19 and CM21)**

7 With respect to other conservation measures, Alternative 2A would be the same as Alternative 4.  
8 Consequently, the effects associated with these other conservation measures would also be the same  
9 for both alternatives.

## 10 **11.0.2.5 Alternative 2B—Summary of Effects**

### 11 **Overview**

12 Alternative 2B would include the same physical/structural water conveyance components, including  
13 a surface canal and eastern alignment, culvert and tunnel siphons, and bridges as Alternative 1B.  
14 Like Alternatives 1A and 1B, Alternative 2B would include five intake facilities on the Sacramento  
15 River. Intakes one through three would be in the same locations as Alternatives 1A and 1B, but the  
16 locations of the fourth and fifth intakes may be located downstream of the intakes described in  
17 Alternative 1A. Overall, construction impacts associated with Alternative 2B would be the same as  
18 those described for Alternative 1B.

19 Currently, as an alternative to Intakes 1–5, intake locations 1, 2, 3, 6, and 7 are being considered.  
20 Selection of intake locations 6 and 7 would entail construction in the same region (north Delta) and  
21 would result in the same construction effects on fish species as discussed for Alternative 1A. This  
22 alternative would convey water from five fish-screened intakes between Clarksburg and Walnut  
23 Grove (Intakes 6 and 7, if selected, would be downstream of Sutter and Steamboat Sloughs) to a new  
24 Byron Tract Forebay adjacent to CCF. Construction effects for all fish species would be similar to  
25 those analyzed for Alternative 1A.

26 Alternative 2B water conveyance operational criteria (Operational Scenario B) would be the same as  
27 Alternative 2A.

28 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
29 these CMs would be identical to those under Alternatives 2A and 1A.

### 30 **Construction and Maintenance of CM1**

31 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
32 affect the covered fish species would typically be proportional to the number of north Delta intakes  
33 constructed, and the total area of habitat affected. Alternative 2B includes the same number of  
34 intakes (five) as Alternative 1A, and potentially the same intake locations, such that the total area  
35 affected by intake construction would be similar (see Table 11-1A-SUM1). Unlike Alternative 1A,  
36 Alternative 2B includes an east side conveyance canal, and one barge landing, such that most of the  
37 in-water construction activities would be about the same.

1 At each Alternative 2B intake, between 1.2 and 6.9 acres of river area would be isolated behind  
 2 cofferdams, and temporarily or permanently lost, for an estimated maximum total of between 27.1  
 3 and 28. This range is the same as for Alternative 2A and similar to the areas affected by Alternative  
 4 1A. During the in-water construction period, a total of up to about 26.0 acres of in-water habitat  
 5 would be affected by dredging activities, resulting in the loss or alteration of about 5% less low-  
 6 quality spawning, rearing, and migration habitat for covered fish species than Alternative 1A (see  
 7 Table 11-1A-SUM1). Likewise, the footprint of the intake and transition wall structures would result  
 8 in permanent loss of between 11,350 and 11,900 feet of primarily steep-banked and riprapped  
 9 shoreline habitat, which is similar to Alternative 1A. The barge landings would include in-water and  
 10 over-water structures, occupying approximately 15,000 square feet of shoreline habitat.

11 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
 12 potential to cause adverse effects on covered species, although these adverse effects would be  
 13 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
 14 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
 15 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
 16 constructing in areas that have limited use by the covered species, adhering to the approved in-  
 17 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
 18 by construction activities, the effects would not limit overall population productivity.

19 In summary, construction and maintenance activities would result in limited temporary and  
 20 permanent effects on the covered fish species or their habitat, and slightly less effects than  
 21 Alternative 1A. While these effects would vary by species and species life stages, the implementation  
 22 of environmental commitments and BMPs (see Appendix 3B, *Environmental Commitments*), would  
 23 reduce most of these construction effects to be not adverse and less than significant. The  
 24 implementation of habitat restoration activities, particularly CM6 *Channel Margin Enhancement*,  
 25 would offset effects of habitat loss or alteration at the intake sites.

### 26 **Water Operations of CM1**

27 With respect to water operations of CM1, Alternative 2B is the same as Alternative 2A.  
 28 Consequently, all the effects associated with water operations of CM1 under Alternative 2B are the  
 29 same as those described above under the Alternative 2A summary.

### 30 **Restoration Measures (CM2, CM4–CM7, and CM10)**

31 With respect to restoration measures, Alternative 2B is the same as Alternatives 2A and 1A.  
 32 Consequently, all the effects associated with restoration measures under Alternative 2B are the  
 33 same as those described above under the Alternative 1A summary.

### 34 **Other Conservation Measures (CM12–CM19 and CM21)**

35 With respect to other conservation measures, Alternative 2B is the same as Alternatives 2A and 1A.  
 36 Consequently, all the effects associated with other conservation measures under Alternative 2B are  
 37 the same as those described above under the Alternative 1A summary.

### 38 **Comparison of Alternative 2B to Alternative 4 (Proposed Project)**

39 Alternative 2B would divert up to 15,000 cfs of water from the north Delta via five screened intakes  
 40 on the east bank of the Sacramento River between Clarksburg and Walnut Grove. This water would  
 41 be conveyed to the south Delta through an surface canal east of the river, with invert culvert siphons

1 needed to cross seven streams/sloughs along the route. While Alternative 4 would consist of  
2 constructing similar intake facilities, in this same area of the river, it includes only three intakes,  
3 with a total combined capacity of 9,000 cfs. While the Alternative 4 tunnel/pipeline structure would  
4 not require any culvert siphons, it would require five more barge landings (six total) to support the  
5 construction process, compared to Alternative 2B (one landing).

6 Alternative 2B would follow Operational Scenario B, while Alternative 4 would follow Operational  
7 Scenario H, resulting in different patterns of water withdrawals from the north Delta, and  
8 potentially different effects on water quality and aquatic habitat conditions in the Plan Area. As fully  
9 described in Chapter 3, *Description of Alternatives*, Alternative 4 operations incorporate a decision  
10 tree process that results in four potential operational sub-scenarios, depending on the outcome of  
11 the decision tree process for spring outflow and Fall X2 operations.

## 12 **Construction and Maintenance of CM1**

13 The potential for construction and maintenance activities to affect the covered fish species would  
14 typically be proportional to the number of north Delta intakes constructed, and the total area of  
15 habitat affected. As a result, Alternative 2B would have substantially greater potential for effects  
16 than Alternative 4, because it includes the construction of two additional intakes (five total). The  
17 additional intakes would also require dredging to re-contour the adjacent streambed. These effects  
18 would be the same as those described above for Alternatives 1A and 1B (see Table 11-1A-SUM1).

19 In addition to the increased intake construction effects for Alternative 2B, compared to Alternative  
20 4, the construction of seven invert culvert siphons for the water conveyance canal to cross stream  
21 and sloughs would result in additional in-water construction work. These siphons could result in up  
22 to about 8 acres of additional in-water disturbance, compared to Alternative 4, and the same as  
23 discussed above for Alternative 1B. As with Alternative 1B, Alternative 2B would require five fewer  
24 barge landings than Alternative 4, each with over-water structures occupying approximately 15,000  
25 square feet of area.

26 As discussed above, in-water and nearshore construction activities have the potential to cause  
27 adverse effects on covered species, although these adverse effects would be effectively avoided and  
28 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
29 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
30 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
31 that have limited use by the covered species, adhering to the approved in-water work windows, and  
32 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
33 the effects would not limit overall population productivity.

34 In summary, construction and maintenance activities would result in limited temporary and  
35 permanent effects on the covered fish species and their habitat. While these effects would vary by  
36 species and species life stages, the implementation of environmental commitments and BMPs (see  
37 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
38 not adverse and less than significant. The implementation of habitat restoration activities,  
39 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
40 the intake sites.

## 1 **Water Operations of CM1**

2 With respect to water operations, Alternative 2B would be the same as Alternative 2A. Please refer  
3 to the comparison of Alternative 2A to Alternative 4.

## 4 **Restoration Measures (CM2, CM4–CM7, and CM10)**

5 With respect to restoration measures, Alternative 2B would be the same as Alternative 4.  
6 Consequently, the effects of these measures would also be the same.

## 7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 With respect to other conservation measures, Alternative 2B would be the same as Alternative 4.  
9 Consequently, the effects associated with these other conservation measures would also be the same  
10 for both alternatives.

## 11 **11.0.2.6 Alternative 2C—Summary of Effects**

### 12 **Overview**

13 Alternative 2C would have the same physical/structural water conveyance components and west  
14 alignment as Alternative 1C. Overall construction impacts from Alternative 2C would be similar to  
15 Alternative 1A but with additional in-water work such as culvert siphons and bridge crossings that  
16 are described under Alternative 1C.

17 Water supply and conveyance operations would follow the guidelines described as Operational  
18 Scenario B. Therefore, Alternative 2C has the same diversion and conveyance operations as  
19 Alternative 2A; consequently, the analysis under Alternative 2A is applicable to Alternative 2C.

20 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
21 these CMs would be identical to those under Alternatives 2A and 1A.

### 22 **Construction and Maintenance of CM1**

23 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
24 affect the covered fish species would typically be proportional to the number of north Delta intakes  
25 constructed, and the total area of habitat affected. Alternative 2C includes the same number of  
26 intakes (five) and the same intake locations as Alternative 1C. Therefore, the total area affected by  
27 intake construction would be similar to Alternative 1C. Both of these alternatives would also have  
28 similar overall effects as Alternative 1A, which also has the same number of intakes (see Table 11-  
29 1A-SUM1). Unlike Alternative 1A, Alternative 2C includes a west side conveyance canal, and two  
30 barge landings, such that most of the in-water construction activities would be about the same.

31 At each Alternative 2C intake, between 1.4 and 7.8 acres of river area would be isolated behind  
32 cofferdams, and temporarily or permanently lost, for an estimated maximum total of 32.7 acres.  
33 Although these areas vary by intake, the overall range of effects would be slightly (about 14%)  
34 greater than Alternative 1A. During the in-water construction period, a total of up to about 20.3  
35 acres of in-water habitat would be affected by dredging activities, this loss or alteration of low-  
36 quality spawning, rearing, and migration habitat for covered fish species would be about 25% less  
37 than for Alternative 1A (see Table 11-1A-SUM1). Likewise, the footprint of the intake and transition  
38 wall structures would result in permanent loss of about 10,100 feet of primarily steep-banked and  
39 riprapped shoreline habitat, or about 15% less than for Alternative 1A. The barge landings would

1 include in-water and over-water structures, occupying approximately 15,000 square feet of  
2 shoreline habitat, although this would be about 67% less than for Alternative 1A.

3 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
4 potential to cause adverse effects on covered species, although these adverse effects would be  
5 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
6 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
7 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
8 constructing in areas that have limited use by the covered species, adhering to the approved in-  
9 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
10 by construction activities, the effects would not limit overall population productivity.

11 In summary, construction and maintenance activities would result in limited temporary and  
12 permanent effects on the covered fish species or their habitat. While these effects would vary by  
13 species and species life stages, the implementation of environmental commitments and BMPs (see  
14 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
15 not adverse and less than significant. The implementation of habitat restoration activities,  
16 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
17 the intake sites.

#### 18 **Water Operations of CM1**

19 With respect to water operations of CM1, Alternative 2C is the same as Alternative 2A. Consequently,  
20 all the effects associated with water operations of CM1 under Alternative 2C are the same as those  
21 described above under the Alternative 2A summary.

#### 22 **Restoration Measures (CM2, CM4–CM7, and CM10)**

23 With respect to restoration measures, Alternative 2C is the same as Alternatives 2A and 1A.  
24 Consequently, all the effects associated with restoration measures under Alternative 2C are the  
25 same as those described above under the Alternative 1A summary.

#### 26 **Other Conservation Measures (CM12–CM19 and CM21)**

27 With respect to other conservation measures, Alternative 2C is the same as Alternatives 2A and 1A.  
28 Consequently, all the effects associated with other conservation measures under Alternative 2C are  
29 the same as those described above under the Alternative 1A summary.

#### 30 **Comparison of Alternative 2C to Alternative 4 (Proposed Project)**

31 Alternative 2C would convey up to 15,000 cfs of water from the north Delta to the south Delta  
32 through a surface canal on the west side of the Sacramento River, from five screened intakes  
33 constructed between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). While Alternative 4  
34 would construct similar intake facilities in this portion of the river, it would include only three  
35 intakes (9,000 cfs combined total capacity), and the intakes would be on the east side of the river.  
36 While Alternative 4 would tunnel under a number of waterways along the conveyance route, the  
37 surface canal for Alternative 2C would use culvert siphons to pass under nine waterways, requiring  
38 in-water construction. Alternative 2C would also have two barge landings and 16 bridge crossings  
39 compared to six barge landings and no bridge crossings for Alternative 4.

1 Alternative 2C would follow Operational Scenario B, while Alternative 4 would follow Operational  
 2 Scenario H, resulting in different patterns of water withdrawals from the north Delta, and  
 3 potentially different effects on water quality and aquatic habitat conditions in the Plan Area. As fully  
 4 described in Chapter 3, *Description of Alternatives*, Alternative 4 operations incorporate a decision  
 5 tree process that results in four potential operational sub-scenarios, depending on the outcome of  
 6 the decision tree process for spring outflow and Fall X2 operations.

### 7 **Construction and Maintenance of CM1**

8 The potential for construction and maintenance activities to affect the covered fish species would  
 9 typically be proportional to the number of north Delta intakes constructed, and the total area of  
 10 habitat affected. As a result, Alternative 2C would have substantially greater potential for effects  
 11 than Alternative 4, because it includes the construction of two additional intakes (five total). The  
 12 additional intakes would also require dredging to re-contour the adjacent streambed. These effects  
 13 would be the similar to those described above for Alternative 1A and 1C (see Table 11-1A-SUM1).

14 In addition to the increased intake construction effects for Alternative 2C, the construction of nine  
 15 invert culvert siphons for the water conveyance canal to cross stream and sloughs would have  
 16 additional in-water effects. These siphons could result in up to about 6 acres of additional in-water  
 17 disturbance, compared to Alternative 4, which would tunnel under the water crossings without  
 18 requiring in-water work. In contrast to the additional in-water construction activities for the intakes  
 19 and canal facilities, Alternative 2C would require four fewer barge landings than Alternative 4 each  
 20 with over-water structures occupying approximately 15,000 square feet of area.

21 As discussed above, in-water and nearshore construction activities have the potential to cause  
 22 adverse effects on covered species, although these adverse effects would be effectively avoided and  
 23 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
 24 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
 25 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
 26 that have limited use by the covered species, adhering to the approved in-water work windows, and  
 27 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
 28 the effects would not limit overall population productivity.

29 In summary, construction and maintenance activities would result in limited temporary and  
 30 permanent effects on the covered fish species and their habitat. While these effects would vary by  
 31 species and species life stages, the implementation of environmental commitments and BMPs (see  
 32 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
 33 not adverse and less than significant. The implementation of habitat restoration activities,  
 34 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
 35 the intake sites.

### 36 **Water Operations of CM1**

37 With respect to water operations, Alternative 2C would be the same as Alternative 2A. Please refer  
 38 to the comparison of Alternative 2A to Alternative 4.

### 39 **Restoration Measures (CM2, CM4–CM7, and CM10)**

40 With respect to restoration measures, Alternative 2C would be the same as Alternative 4.  
 41 Consequently, the effects of these measures would also be the same.

## 1 Other Conservation Measures (CM12–CM19 and CM21)

2 With respect to other conservation measures, Alternative 2C would be the same as Alternative 4.  
3 Consequently, the effects associated with these other conservation measures would also be the same  
4 for both alternatives.

### 5 11.0.2.7 Alternative 3—Summary of Effects

#### 6 Overview

7 Alternative 3 is the same as Alternative 1A except that it includes two intakes rather than five.  
8 Intakes 1 and 2 would be constructed instead of Intakes 1, 2, 3, 4, and 5. Alternative 3 also includes  
9 Operational Scenario A as does Alternative 1A. However, while Alternative 1A would divert up to  
10 15,000 cfs in the north Delta, Alternative 3 would divert up to 6,000 cfs.

#### 11 Construction and Maintenance of CM1

12 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
13 affect the covered fish species would typically be proportional to the number of north Delta intakes  
14 constructed, and the total area of habitat affected. Alternative 3 includes two intakes, which is three  
15 less than the five intakes for Alternative 1A. Therefore, the total area displaced by the intakes would  
16 be about 13.5 acres less for Alternative 3 (see Table 11-1A-SUM1). Similar to Alternative 1A,  
17 Alternative 3 includes a conveyance tunnel, with six barge landings.

18 At each Alternative 3 intake, between 1.2 and 6.0 acres of river area would be isolated behind  
19 cofferdams, and temporarily or permanently lost, for an estimated maximum total of 11 acres.  
20 Although these areas vary by intake, the overall range of effects would be slightly less than  
21 Alternative 1A. During the in-water construction period, a total of up to about 10.2 acres of in-water  
22 habitat would be affected by dredging activities, this loss or alteration of low-quality spawning,  
23 rearing, and migration habitat for covered fish species would be about 63% less than for Alternative  
24 1A (see Table 11-1A-SUM1). Similarly, the footprint of each intake and transition wall structures  
25 would result in permanent loss of about 4,450 feet of primarily steep-banked and ripped  
26 shoreline habitat, also about 63% less than for Alternative 1A. The barge landings would include in-  
27 water and over-water structures, occupying approximately 15,000 square feet of shoreline habitat.

28 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
29 potential to cause adverse effects on covered species, although these adverse effects would be  
30 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
31 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
32 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
33 constructing in areas that have limited use by the covered species, adhering to the approved in-  
34 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
35 by construction activities, the effects would not limit overall population productivity.

36 In summary, construction and maintenance activities would result in limited temporary and  
37 permanent effects on the covered fish species or their habitat. While these effects would vary by  
38 species and species life stages, the implementation of environmental commitments and BMPs (see  
39 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
40 not adverse and less than significant. The implementation of habitat restoration activities,

1 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
2 the intake sites.

### 3 **Water Operations of CM1**

4 The methods and analysis of Alternative 3 are the same as those previously described for  
5 Alternative 1A. However, Alternative 3 includes two intakes rather than the five utilized in  
6 Alternative 1A, while Alternative 3 uses the same water Operational Scenario A as Alternative 1A.  
7 Since the size of the conveyance infrastructure and the water diversion differs, the effects are  
8 different.

### 9 **Changes in Exports and Outflow**

10 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
11 Alternative 3 are anticipated to increase by 227 TAF relative to Existing Conditions, and by 930 TAF  
12 relative to the No Action Alternative. Over the long-term, approximately 35% of the exported water  
13 will be from the new north Delta intakes, and average monthly diversions at the south Delta intakes  
14 would correspondingly decrease. These changes would increase the proportion of San Joaquin River  
15 water flowing throughout the south, west, and interior Delta, and a corresponding decrease in the  
16 proportion of Sacramento River water but not to the same extent as Alternative 1A.

17 Under Alternative 3, long-term average annual Delta outflow is anticipated to decrease 227 TAF  
18 relative to Existing Conditions and by 977 TAF relative to the NAA. It is important to note that some  
19 outflow changes under Alternative 3 are greater relative to NAA because Existing Conditions and  
20 Alternative 3 do not include operations to meet Fall X2, whereas NAA does include Fall X2.

21 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
22 diverted in December through mid-June and less water diverted mid-June through November), there  
23 would be beneficial, not adverse/less than significant, and adverse/significant and unavoidable  
24 effects/impacts on fish under Alternative 3. Following is a summary of these effects as they relate to  
25 the key factors of entrainment and flow, which in turn affects fish survival and spawning, rearing,  
26 and migration habitat conditions.

### 27 **Entrainment**

28 Similar to Alternative 1A, overall entrainment of a number of species under Alternative 3 would be  
29 slightly less than or similar to the levels experienced in the recent years, except for longfin smelt and  
30 spring- and fall-/last fall-run Chinook salmon. This is because the north Delta diversion operations  
31 would reduce reliance on south Delta export facilities (greater entrainment rates are expected to  
32 occur at south Delta facilities), along with additional minor benefits from decommissioning of  
33 agricultural diversions in restoration areas and implementation of an alternative intake for the  
34 North Bay Aqueduct. Effects would be significant and adverse for these three species, primarily  
35 because of the increase in reverse OMR flows.

36 Since the proposed north Delta intakes under Alternative 3 are the same design as those proposed  
37 under Alternative 1A, the potential to affect some fish species through contact with the screens  
38 and/or increased predation around those facilities still exists but to a lesser extent because of the  
39 fewer number of intakes (two as compared to five). Regardless, these effects are considered to be  
40 not adverse.

1 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
2 in the Delta except for longfin smelt. There are very few instances where there would be increases,  
3 but these are substantially offset by decreases during other periods. Effects are at a minimum not  
4 adverse and less than significant.

### 5 **Flows**

6 While San Joaquin River flows are not expected to be affected by Alternative 3, flow changes are  
7 expected in the Sacramento River and its tributaries, as well as within the Sacramento-San Joaquin  
8 Delta. Changes in flow will result from changes in releases from upstream reservoirs, diversions  
9 from the south Delta, and reductions in flows downstream of the proposed north Delta intakes.

10 Rearing habitat conditions for juvenile delta smelt are considered with respect to a fall abiotic  
11 habitat index with and without the assumption that habitat restoration benefits are realized.  
12 Assuming habitat benefits are realized, the abiotic habitat index under Alternative 3 would be 25%  
13 lower than NAA in wet water year types, 8% lower in above normal water year types, but 24–35%  
14 greater than baseline in other water year types. The average abiotic habitat index for Alternative 3  
15 with habitat restoration would be about the same as NAA assuming 100% habitat occupancy by  
16 delta smelt. However, migration conditions are not expected to substantially change under  
17 Alternative 3.

18 Under Alternative 3 longfin smelt relative abundance would be reduced 14–17% in above normal  
19 water year types, and reduced 13–15% in below normal water year types compared to NAA.  
20 However, longfin smelt might benefit from habitat restoration in Cache Slough, west Delta, and  
21 Suisun Bay, through potential additional food production and export to rearing areas.

22 With regard to salmonids, several issues were identified as described below with a number of them  
23 resulting in adverse and/or significant effects. For example, Sacramento River attraction flows for  
24 migrating adult salmonids would be lower from operations of the north Delta diversions under  
25 Alternative 3, but not to an adverse level. Winter-run Chinook salmon would be adversely affected  
26 by the reduced extent and quality of fry and juvenile rearing and migration habitat, as a result of  
27 reduced flows, although the effects on spawning and egg incubation conditions are currently  
28 uncertain. However, Alternative 3 would reduce spawning habitat conditions to an adverse level for  
29 spring-run salmonids, as well as migration conditions for meaningful portions of the fall-run and  
30 late fall-run Chinook salmon populations, although the potential effects on spring-run Chinook  
31 salmon migration conditions are uncertain.

32 Steelhead would be adversely affected for several parameters under Alternative 3. Compared to  
33 Existing Conditions, the quantity and quality of rearing and migration habitat would be substantially  
34 reduced due to decreases in flow in the Feather River and American River. Flows generally improve  
35 and are beneficial in the Trinity River and Clear Creek. However, due to uncertainties, the overall  
36 effects of Alternative 3 on steelhead migration conditions cannot be determined with available  
37 modeling data, but will be reassessed with future modeling results.

38 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
39 the Yolo Bypass provide benefits to Sacramento splittail, primarily with regard to spawning and  
40 migration.

1 For green and white sturgeon, reduced upstream flows under Alternative 3 would result in some  
2 reductions in rearing, spawning, and migration habitat. While most of these effects would not be  
3 significant or adverse, a significant and unavoidable adverse impacts to green sturgeon migration  
4 habitat conditions would occur. While proposed mitigation has the potential to reduce the severity  
5 of impact, this would not necessarily result in a not adverse determination. However, based on an  
6 apparent positive correlation between Delta outflows and white sturgeon year-class strength, the  
7 effects of Alternative 3 on white sturgeon migration conditions are uncertain, as the exact  
8 mechanism driving this correlation is not known. These targeted investigations are expected to  
9 identify the primary mechanisms that drive sturgeon year-class strength, and the final  
10 determination of the overall effects of Alternative 3 relative to NAA.

11 Similar to sturgeon, Alternative 3 would affect spawning and egg incubation habitat for lamprey  
12 species as a result of increased water temperatures on the Feather River and redd dewatering in the  
13 Sacramento and American rivers. Flow reductions on several waterways, including the Sacramento,  
14 Trinity, and American rivers, when compared to Existing Conditions, would have an adverse effect  
15 on Pacific lamprey spawning and incubation conditions. While substantial flow changes would  
16 occur, these changes would not result in a significant impact on river lamprey because the  
17 differences are primarily the result of climate change, sea level rise and future water demand and  
18 not attributable to the alternative.

19 As evidenced by this summary, changes in flow under Alternative 3 are adverse to some fish species.  
20 Alternative 3 also includes the same conservation measures as Alternative 1A which provide  
21 substantial habitat improvements for fish. When the flow and habitat restoration measures are  
22 considered together, many of the effects of Alternative 3 measures are beneficial or not adverse  
23 and/or less than significant. However, several effects resulting from changes in flows upstream of  
24 the Delta remain adverse and/or significant and unavoidable. While adaptive management  
25 mitigation measures would also be implemented to reduce the severity of effects, such reductions  
26 would not necessarily reach a not adverse or less than significant level.

27 Summary Table 11-3-SUM1 presents the results of the flow related effects on fish.

1 **Table 11-3-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	NA/LTS	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	A/SU		ND/S (combined)	
Winter-Run Chinook salmon	B/B	ND/LTS	A/SU	A/LTS
Spring-Run Chinook salmon	A/S	A/SU	NA/LTS	ND/LTS
Fall-Run/Late Fall-Run Chinook salmon	A/S	NA/LTS	NA/LTS	A/SU
Steelhead	NA/LTS	NA/LTS	A/SU	ND/LTS
Sacramento splittail	NA/B	NA/LTS	B/B	NA/LTS
Green sturgeon	NA/LTS	NA/LTS	NA/LTS	A/SU
White sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	A/SU	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 3 is the same as Alternative 1A. Consequently, all  
5 the effects associated with restoration measures under Alternative 3 are the same as those  
6 described above under the Alternative 1A summary.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 With respect to other conservation measures, Alternative 3 is the same as Alternative 1A.  
9 Consequently, all the effects associated with other conservation measures under Alternative 3 are  
10 the same as those described above under the Alternative 1A summary.

11 **Comparison of Alternative 3 to Alternative 4 (Proposed Project)**

12 Alternative 3 would convey up to 6,000 cfs of water from two screened north Delta intakes on the  
13 east bank of the Sacramento River near Clarksburg, and pipeline/tunnel conveyance facilities to the  
14 south Delta. While Alternative 4 would have a similar conveyance structure, it would have one  
15 additional intake (three total), with a total capacity of 9,000 cfs.

16 Alternative 3 would also have a different operating scenario (Scenario A) than Alternative 4  
17 (Scenario H), resulting in different patterns of water withdrawals from the north Delta, and  
18 potentially different effects on water quality and aquatic habitat conditions in the Plan Area. As fully  
19 described in Chapter 3, *Description of Alternatives*, Alternative 4 operations incorporate a decision  
20 tree process that results in four potential operational sub-scenarios, depending on the outcome of  
21 the decision tree process for spring outflow and Fall X2 operations.

## 1 **Construction and Maintenance of CM1**

2 The potential for construction and maintenance activities to affect the covered fish species would  
 3 typically be proportional to the number of north Delta intakes constructed, and the total area of  
 4 habitat affected. As a result, Alternative 3 would have a lower potential for effects than Alternative 4  
 5 because it includes the construction of one less intake (two). This would result in up to about 5.2  
 6 acres (32%) less in-water area affected by construction activities than for Alternative 4. In addition,  
 7 the total length of shoreline permanently replaced by the intakes (up to about 4,450 feet) would be  
 8 30% less than Alternative 4 (see Table 11-1A-SUM1). In addition to the effects of intake  
 9 construction, Alternative 3 would require about 40% less dredging (about 6.9 acres) to re-contour  
 10 the streambed adjacent to the intake structures. However, both alternatives include a  
 11 tunnel/pipeline conveyance system, and six barge landings to support tunnel construction. Each  
 12 barge landing would include in-water and over-water structures, occupying approximately 15,000  
 13 square feet of nearshore habitat.

14 As discussed above, in-water and nearshore construction activities have the potential to cause  
 15 adverse effects on covered species, although these adverse effects would be effectively avoided and  
 16 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
 17 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
 18 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
 19 that have limited use by the covered species, adhering to the approved in-water work windows, and  
 20 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
 21 the effects would not limit overall population productivity.

22 In summary, construction and maintenance activities would result in limited temporary and  
 23 permanent effects on the covered fish species and their habitat. While these effects would vary by  
 24 species and species life stages, the implementation of environmental commitments and BMPs (see  
 25 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
 26 not adverse and less than significant. The implementation of habitat restoration activities,  
 27 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
 28 the intake sites.

## 29 **Water Operations of CM1**

30 Water operations under Alternative 3 differ from Alternative 4 in several ways. Alternative 3  
 31 includes two intakes in the north Delta to convey up to 6,000 cfs, while Alternative 4 utilizes three  
 32 intakes and can convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*, average annual  
 33 exports under Alternative 3 are anticipated to be 5,371 TAF, which is greater than anticipated  
 34 exports under all four operational scenarios for Alternative 4 (4,414 to 5,255 TAF). Average annual  
 35 exports under Alternative 3 would also be greater than Existing Conditions (5,144 TAF), as well as  
 36 NAA (4,441 TAF).

37 Changes in anticipated long-term average annual Delta outflow under Alternative 4 also vary  
 38 between the operational scenarios (H1-H4). The average annual outflows would be greater for all  
 39 the Alternative 4 operational scenarios than Alternative 3 (between 113 and 972 TAF greater).  
 40 Alternative 3 would result in lower annual average outflow (about 228 TAF) than Existing  
 41 Conditions, but about 977 TAF less than NAA.

42 There are various benefits for some species under both alternatives; Alternative 4 provides  
 43 beneficial effects on entrainment of longfin smelt, spring-run Chinook salmon, and Sacramento

1 splittail migration, while Alternative 3 is beneficial to winter-run Chinook salmon and Sacramento  
 2 splittail. The substantive difference is that while Alternative 3 results in adverse effects/significant  
 3 and unavoidable impacts on longfin smelt entrainment, Alternative 4 would be beneficial. The  
 4 effects on longfin smelt spawning, rearing, and migration conditions, are uncertain for both  
 5 alternatives. Alternative 3 would also result in adverse effects/significant and unavoidable impacts  
 6 on migration and rearing of winter-run Chinook salmon; migration for fall-/late fall-run Chinook  
 7 salmon; steelhead rearing; migration for green sturgeon; and spawning for Pacific lamprey.

#### 8 **Restoration Measures (CM2, CM4–CM7, and CM10)**

9 With respect to restoration measures, Alternative 3 would be the same as Alternative 4.  
 10 Consequently, the effects of these measures would also be the same.

#### 11 **Other Conservation Measures (CM12–CM19 and CM21)**

12 With respect to other conservation measures, Alternative 3 would be the same as Alternative 4.  
 13 Consequently, the effects associated with these other conservation measures would also be the same  
 14 for both alternatives.

### 15 **11.0.2.8 Alternative 4—Summary of Effects**

#### 16 **Overview**

17 Alternative 4 is similar to Alternative 1A except that it includes three intakes rather than five.  
 18 Intakes 2, 3, and 5 would be constructed instead of Intakes 1, 2, 3, 4, and 5. As a result, Alternative 4  
 19 would divert up to 9,000 cfs of water from the north Delta, compared to a maximum of 15,000 cfs  
 20 under Alternative 1A. However, it includes the same number and location of barge landings as  
 21 discussed above for Alternative 1A. As indicated above, Alternative 4 would follow Operational  
 22 Scenario H, which incorporates a decision tree process (see Chapter 3, *Description of Alternatives*)  
 23 that results in four potential operational sub-scenarios, depending on the outcome of the decision  
 24 tree process for spring outflow and Fall X2 operations.

#### 25 **Construction and Maintenance of CM1**

26 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
 27 affect the covered fish species would typically be proportional to the number of north Delta intakes  
 28 constructed, and the total area of habitat affected. Alternative 4 includes only three intakes,  
 29 compared to the five intakes for Alternative 1A. Therefore, the total area affected by intakes would  
 30 be about 16.7 acres less for Alternative 4 (see Table 11-1A-SUM1). Similar to Alternative 1A,  
 31 Alternative 4 includes a conveyance tunnel, with six barge landings.

32 At each Alternative 4 intake, between 1.3 and 6.9 acres of river area would be isolated behind  
 33 cofferdams, and temporarily or permanently lost, for an estimated maximum total of 16.2 acres.  
 34 Although these areas vary by intake, the overall range of effects would be slightly lower than  
 35 Alternative 1A. During the in-water construction period, a total of up to about 17.1 acres of in-water  
 36 habitat would be affected by dredging activities, this loss or alteration of low-quality spawning,  
 37 rearing, and migration habitat for covered fish species would be about 37% less than for Alternative  
 38 1A (see Table 11-1A-SUM1). Similarly, the footprint of each intake and transition wall structures  
 39 would result in permanent loss of about 6,360 feet of primarily steep-banked and riprapped

1 shoreline habitat, about 47% less than for Alternative 1A. The barge landings would include in-  
2 water and over-water structures, occupying approximately 15,000 square feet of shoreline habitat.

3 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
4 potential to cause adverse effects on covered species, although these adverse effects would be  
5 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
6 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
7 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
8 constructing in areas that have limited use by the covered species, adhering to the approved in-  
9 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
10 by construction activities, the effects would not limit overall population productivity.

11 In summary, construction and maintenance activities would result in limited temporary and  
12 permanent effects on the covered fish species or their habitat. While these effects would vary by  
13 species and species life stages, the implementation of environmental commitments and BMPs (see  
14 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
15 not adverse and less than significant. The implementation of habitat restoration activities,  
16 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
17 the intake sites.

## 18 **Water Operations of CM1**

19 The methods and analysis of Alternative 4 are the same as those previously described for  
20 Alternative 1A. However, Alternative 4 includes three intakes rather than the five utilized in  
21 Alternative 1A. Alternative 4 also includes different water conveyance operational criteria  
22 (Operational Scenario H) than Alternative 1A (Operational Scenario A), resulting in different  
23 patterns of water withdrawals from the north Delta, and potentially different effects on water  
24 quality and aquatic habitat conditions in the Plan Area. As fully described in Chapter 3, *Description of*  
25 *Alternatives*, Alternative 4 operations incorporate a decision tree process that results in four  
26 potential operational sub-scenarios, depending on the outcome of the decision tree process for  
27 spring outflow and Fall X2 operations. These alternative outflow scenarios for spring and fall have  
28 the potential to cause differences in upstream conditions or in-Delta flows in other seasons as well  
29 (i.e., summer and winter). The four potential operational outcomes of the decision tree are as  
30 follows:

- 31 ● Scenario H1 – Low outflow scenario (LOS) excludes enhanced spring outflow and excludes Fall  
32 X2 operations.
- 33 ● Scenario H2 - includes enhanced spring outflow, but excludes Fall X2 operations. This scenario  
34 lies within the range of the other scenarios.
- 35 ● Scenario H3 – Evaluated starting operations (ESO) excludes enhanced spring outflow, but  
36 includes Fall X2 operations.
- 37 ● Scenario H4 – High outflow scenario (HOS) includes enhanced spring outflow, and includes Fall  
38 X2 operations.

39 The intent of Alternative 4 is to use the decision tree to test operational scenarios in order to achieve  
40 results that are not adverse and are less than significant. The operations impact analysis compares  
41 late long term (LLT) results for Existing Conditions (CEQA) or no action (NEPA) with the range of  
42 outcomes from the operational sub-scenarios (H1–H4), and concludes with a single impact

1 statement for each issue. Since the size of the conveyance infrastructure and the water diversion  
2 differs, the effects are different than those described for Alternative 1A.

3 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
4 these CMs would be identical to those under Alternative 1A.

### 5 ***Changes in Exports and Outflow***

6 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
7 Alternative 4 are anticipated to increase relative to Existing Conditions by 111 TAF under scenario  
8 H1 and decrease relative to Existing Conditions by 434 TAF (under scenario H2), 199 TAF (under  
9 scenario H3), and 730 TAF (under scenario H4). Relative to the No Action Alternative, average  
10 annual Delta exports are anticipated to increase by 814 TAF (under scenario H1), 269 TAF (under  
11 scenario H2), and 504 TAF (under scenario H3), while they are expected to decrease relative to the  
12 No Action Alternative by 27 TAF under scenario H4. Over the long-term, approximately 48%  
13 (H1:47%, H2:46%, H3:49%, H4:49%) of the exported water will be from the new north Delta  
14 intakes, and average monthly diversions at the south Delta intakes would correspondingly decrease.  
15 These changes would increase the proportion of San Joaquin River water flowing throughout the  
16 South, West, and Interior Delta, and a corresponding decrease in the proportion of Sacramento River  
17 water.

18 Under Alternative 4, long-term average annual Delta outflow would vary depending on time of year  
19 and operating scenario (H1–H4). Late-fall and winter outflows remain similar or show minor  
20 reductions in all four Alternative 4 scenarios compared to No Action Alternative. In the spring  
21 months, outflow would decrease under scenarios H1 and H3 as compared to No Action Alternative,  
22 while the enhanced spring outflow requirement under scenarios H2 and H4 would result in  
23 increased or similar outflow compared to No Action Alternative. SWP and CVP exports in summer  
24 months would increase and result in lower outflow under all four scenarios compared to No Action  
25 Alternative. In the fall months, outflow would reduce under Alternative 4 H1 and H2 compared to No  
26 Action Alternative, while it will increase or remain similar under scenarios H3 and H4 because of the  
27 Fall X2 requirement, in wet, above-normal and below-normal years. All four scenarios would show  
28 increased or similar outflow in September and October months of all year types because of the  
29 stringent south Delta export constraints.

30 Long-term average and wet year peak outflows would increase in winter months with a  
31 corresponding decrease in spring months because of the shift in system inflows caused by climate  
32 change and increased Delta exports. In other year types, scenarios H1 and H3 would result in lower  
33 or similar outflow in the spring months, while scenarios H2 and H4 would result in higher or similar  
34 outflow, because of the enhanced spring outflow requirements. In summer and fall months, all four  
35 scenarios would result in similar or higher outflow because of changes in export patterns and  
36 stringent fall south Delta export requirements, and also because of the Fall X2 requirements in  
37 scenarios H3 and H4. The incremental changes in Delta outflow between Alternative 4 (all  
38 scenarios) and Existing Conditions would be a function of both the facility and operations  
39 assumptions of Alternative 4 (including a total north Delta intake capacity of 9,000 cfs, more  
40 restrictive OMR, enhanced spring outflow and/or Fall X2 requirements) and the reduction in water  
41 supply availability due to sea level rise and climate change.

42 Based on results from all four possible outcomes of the Alternative 4, Delta outflow under  
43 Alternative 4 (all scenarios) would likely decrease or remain similar compared to the conditions  
44 without the project.

1 As a result of changes in points of diversion and the quantity and timing of diversions, there would  
2 be a range of effects/impacts on fish under Alternative 4. However, given the flexibility provided by  
3 the sub-scenarios and the primary intent of the decision tree to test operational scenarios in order  
4 to achieve results that are not adverse and are less than significant, the results of Alternative 4  
5 would typically be either beneficial or not adverse/less than significant. Following is a summary of  
6 these effects as they relate to the key factors of entrainment and flow, which in turn affects fish  
7 survival and spawning, rearing, and migration habitat conditions.

### 8 ***Entrainment***

9 Similar to Alternative 1A, overall entrainment of numerous species under Alternative 4 would be  
10 less than or similar to the levels experienced in the recent years. This is because the north Delta  
11 diversion operations would reduce reliance on south Delta export facilities (greater entrainment  
12 rates are expected to occur at south Delta facilities), along with additional minor benefits from  
13 decommissioning of agricultural diversions in restoration areas and implementation of an  
14 alternative intake for the North Bay Aqueduct. Additionally, the reduced exports under Alternative 4  
15 as compared to 1A provide further reductions in entrainment, resulting in improved conditions for  
16 all covered species and beneficial effects for delta and longfin smelt, spring-run Chinook salmon, and  
17 Sacramento splittail.

18 While the degree of reduction in entrainment for longfin smelt would vary among the H1-H4  
19 operational scenarios, beneficial reductions would occur under each scenario. These improvements  
20 would occur at the south Delta facilities as longfin smelt are unlikely to be present at north Delta  
21 facilities.

22 Since the proposed north Delta intakes under Alternative 4 are the same design as those proposed  
23 under Alternative 1A, the potential to affect some fish species through contact with the screens  
24 and/or increased predation around those facilities still exists but at a reduced level when compared  
25 to Alternative 1A because there are two fewer intakes. Regardless, these effects are considered to be  
26 not adverse.

27 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
28 in the Delta. There are very few instances where there would be increases, but these are  
29 substantially offset by decreases during other periods. Effects are at a minimum not adverse and less  
30 than significant, with effects being somewhat beneficial for some species.

### 31 ***Flows***

32 While San Joaquin River flows are not expected to be affected by Alternative 4, flow changes are  
33 expected in the Sacramento River and its tributaries, as well as within the Sacramento-San Joaquin  
34 Delta. Changes in flow will result from changes in releases from upstream reservoirs, diversions  
35 from the south Delta, and reductions in flows downstream of the proposed north Delta intakes.

36 Overall, there would be minimal changes under Alternative 4 to upstream flows, reservoir storage,  
37 or water temperatures. The decision tree process will ensure the impacts of water operations on  
38 rearing habitat for delta smelt are not adverse and support a contribution to recovery of this species.  
39 In the event BDCP habitat restoration does not produce the desired benefits, the average fall abiotic  
40 habitat index across all years would be similar to NAA under Scenarios H3 and H4. Under Scenarios  
41 H1 and H2, which do not include Fall X2, the abiotic habitat index would be lower than NAA.

1 Recognizing the uncertainties of habitat restoration and disagreement regarding the magnitudes of  
2 spring outflow augmentation necessary to support the conservation of longfin smelt, the decision  
3 tree process will identify CM1 operations that are expected to meet the longfin smelt population  
4 growth objective. Those operations will ensure the impacts of water operations on rearing habitat  
5 for longfin smelt are not adverse and support a contribution to recovery of this species.

6 Limited effects are expected on spawning and egg incubation, rearing, and migration conditions for  
7 Chinook salmon species and steelhead. However, the overall modeling results currently support the  
8 finding that the effects are uncertain for winter-run and spring-run Chinook salmon spawning and  
9 egg incubation conditions, as well as migration conditions for winter-, spring-, fall-/late fall-run  
10 Chinook salmon and steelhead. Additional assessments will be needed to confirm that adverse  
11 effects are not reasonably expected to occur to these species under Alternative 4.

12 Small to moderate reductions in flow rates during some summer and fall months are expected in the  
13 Feather River, but these reductions would not have biologically meaningful effects on rearing  
14 habitat of any covered fish species (Table 11-4-SUM1).

15 Flow reductions below the north Delta intakes would not reduce available spawning habitat for  
16 delta smelt under any of the operating scenarios for Alternative 4. The area of fall abiotic habitat for  
17 juvenile delta smelt varies among the operating scenarios for Alternative 4. Without habitat  
18 restoration, operating scenarios H3 and H4 increase fall abiotic habitat area, while H1 results in a  
19 slight reduction compared to NAA. Alternative 4 under all flow operation scenarios would benefit  
20 delta smelt with inclusion of habitat restoration especially in the areas that are closer to delta  
21 smelt's main range. However, due to uncertainties regarding the magnitude of benefits of restored  
22 habitat, the overall determination is that Alternative 4 is not adverse and less than significant to  
23 delta smelt rearing habitat.

24 Winter-spring outflows under Alternative 4 are similar to baselines and do not result in appreciable  
25 decreases in longfin smelt abundance. The analyses conducted as a part of this evaluation did not  
26 include the benefits of habitat restoration, which would provide benefits to longfin smelt. As a result,  
27 rearing and migration conditions are not adversely affected.

28 Improved flow conditions over the Fremont Weir and in the Yolo Bypass provide substantial  
29 benefits to sturgeon, by reducing the stranding potential.

30 While some periods of flow would be higher and some lower, Alternative 4 operating scenarios  
31 would not substantially change conditions for sturgeon spawning, rearing, and migration relative to  
32 the NAA, except for apparent reductions in migration conditions. However, the uncertainty  
33 regarding which mechanisms are responsible for the positive correlation between white sturgeon  
34 year class strength and river/Delta flow will be addressed through targeted research and  
35 monitoring to be conducted in the years leading up to the initiation of north Delta facilities  
36 operations. If these investigations determine that in-Delta and through-Delta flow conditions are the  
37 primary mechanisms behind the positive correlation, then Alternative 4 could be adverse relative to  
38 NAA, but no substantial reductions would occur relative to Existing Conditions. There are also  
39 similar uncertainties regarding the overall effects of Alternative 4 on green sturgeon, relative to  
40 NAA.

41 As evidenced by this summary, a variety of changes in flow will occur under Alternative 4. Some of  
42 these changes are beneficial for fish while others are not. The decision tree component of  
43 Alternative 4 provides flexibility and the alternative is expected to eliminate or minimize adverse

1 effects or significant impacts. Alternative 4 also includes conservation measures that provide  
 2 substantial habitat improvements for fish. These measures include habitat restoration measures and  
 3 several other measures that reduce existing fish stressors in the Delta region (summary description  
 4 provided in the following section). When the flow and habitat restoration measures are considered  
 5 together, the effects of Alternative 4 measures are either beneficial or not adverse and/or less than  
 6 significant. Summary Table 11-4-SUM1 presents the results of the flow related effects on fish.

7 **Table 11-4-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	B/LTS	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	NA/B		ND/LTS (combined)	
Winter-Run Chinook salmon	NA/LTS	ND/LTS	NA/LTS	ND/LTS
Spring-Run Chinook salmon	NA/B	ND/LTS	NA/LTS	ND/LTS
Fall-Run/Late Fall-Run Chinook salmon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Steelhead	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Sacramento splittail	NA/B	NA/LTS	NA/LTS	NA/LTS
Green sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
White sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

8

9 **Restoration Measures (CM2, CM4–CM7, and CM10)**

10 With respect to restoration measures, Alternative 4 is the same as Alternative 1A. Consequently, all  
 11 the effects associated with restoration measures under Alternative 4 are the same as those  
 12 described above under the Alternative 1A summary.

13 **Other Conservation Measures (CM12–CM19 and CM21)**

14 With respect to other conservation measures, Alternative 4 is the same as Alternative 1A.  
 15 Consequently, all the effects associated with other conservation measures under Alternative 4 are  
 16 the same as those described above under the Alternative 1A summary.

## 1 11.0.2.9 Alternative 5—Summary of Effects

### 2 Overview

3 Alternative 5 is the same as Alternative 1A except that it involves only Intake 1 instead of Intakes 1,  
4 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would divert up to  
5 15,000 cfs and uses Operational Scenario A, Alternative 5 would only divert up to 3,000 cfs in the  
6 north Delta and uses Operational Scenario C. Alternative 5 has the same six barge facilities as  
7 Alternative 1A.

8 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
9 these CMs would be identical to those under Alternative 1A.

### 10 Construction and Maintenance of CM1

11 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
12 affect the covered fish species would typically be proportional to the number of north Delta intakes  
13 constructed, and the total area of habitat affected. Alternative 5 includes only one intake, compared  
14 to the five intakes for Alternative 1A. Therefore, the total area displaced by the intake would be  
15 about 23.7 acres (83%) less for Alternative 5 (see Table 11-1A-SUM1). Similar to Alternative 1A,  
16 Alternative 5 includes a conveyance tunnel, with six barge landings.

17 At the one Alternative 5 intake, between 1.2 and 5.0 acres of river area would be isolated behind  
18 cofferdams and temporarily lost. During the in-water construction period, a total of up to about 4.7  
19 acres of in-water habitat would be affected by dredging activities, this loss or alteration of low-  
20 quality spawning, rearing, and migration habitat for covered fish species would also be about 83%  
21 less than for Alternative 1A (see Table 11-1A-SUM1). Similarly, the footprint of the intake and  
22 transition wall structures would result in permanent loss of about 2,050 feet of primarily steep-  
23 banked and riprapped shoreline habitat, also about 83% less than for Alternative 1A. The barge  
24 landings would include in-water and over-water structures, occupying approximately 15,000 square  
25 feet of shoreline habitat.

26 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
27 potential to cause adverse effects on covered species, although these adverse effects would be  
28 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
29 Appendix 3B, *Environmental Commitments*). These include pile driving Minimization Measures  
30 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
31 constructing in areas that have limited use by the covered species, adhering to the approved in-  
32 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
33 by construction activities, the effects would not limit overall population productivity.

34 In summary, construction and maintenance activities would result in limited temporary and  
35 permanent effects on the covered fish species or their habitat. Based on habitat loss or alteration,  
36 Alternative 5 would result in the potential for about 83% fewer impacts than Alternative 1A. While  
37 these effects would vary by species and species life stages, the implementation of environmental  
38 commitments and BMPs (see Appendix 3B, *Environmental Commitments*), would reduce most of  
39 these construction effects to be not adverse and less than significant. The implementation of habitat  
40 restoration activities, particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat  
41 loss or alteration at the intake sites.

## 1 **Water Operations of CM1**

2 The methods and analysis of Alternative 5 are the same as those previously described for  
3 Alternative 1A. However, Alternative 5 includes one intake rather than the five utilized in  
4 Alternative 1A, and Alternative 5 uses water Operational Scenario C. Also, Alternative 5 only diverts  
5 up to 3,000 cfs from the north Delta intakes while Alternative 1A diverts up to 15,000 cfs. Since the  
6 size of the conveyance infrastructure and the water operations scenario differs, the effects are  
7 different.

## 8 ***Changes in Exports and Outflow***

9 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
10 Alternative 5 are anticipated to decrease by 358 TAF relative to Existing Conditions, and increase by  
11 345 TAF relative to the No Action Alternative. Over the long-term, approximately 25% of the  
12 exported water will be from the new north Delta intake, and average monthly diversions at the  
13 south Delta intakes would correspondingly decrease. These changes would slightly increase the  
14 proportion of San Joaquin River water flowing throughout the south, west, and interior Delta, and a  
15 corresponding decrease in the proportion of Sacramento River water.

16 Under Alternative 5, long-term average annual Delta outflow is anticipated to increase 401 TAF  
17 relative to Existing Conditions and to decrease by 349 TAF relative to the NAA. It is important to  
18 note that some outflow changes under Alternative 5 are greater relative to Existing Conditions  
19 because Existing Conditions do not include operations to meet Fall X2, whereas NAA and  
20 Alternative 5 do include Fall X2.

21 As a result of changes in points of diversion and the quantity and timing of diversions (slightly more  
22 water diverted in mid-December to June/July and less water diverted July through mid-December),  
23 there would be beneficial, not adverse/less than significant, and adverse/significant and  
24 unavoidable effects/impacts on fish under Alternative 5. Following is a summary of these effects as  
25 they relate to the key factors of entrainment and flow, which in turn affects fish survival and  
26 spawning, rearing, and migration habitat conditions.

## 27 ***Entrainment***

28 Similar to Alternative 1A, overall entrainment of numerous species under Alternative 5 would be  
29 slightly less than or similar to the levels experienced in the recent years. This is because the north  
30 Delta diversion operations would slightly reduce reliance on south Delta export facilities (greater  
31 entrainment rates are expected to occur at south Delta facilities), along with additional minor  
32 benefits from decommissioning of agricultural diversions in restoration areas and implementation  
33 of an alternative intake for the North Bay Aqueduct. Additionally, the reduced exports under  
34 Alternative 5 as compared to 1A provide further reductions in entrainment, resulting in beneficial  
35 effects for spring-run and fall-run and late fall-run Chinook salmon.

36 Reduced entrainment of juvenile salmonids would occur in the majority of years under all water  
37 year types relative to current conditions, whereas Alternative 1A reductions were only under the  
38 wetter conditions.

39 Since the proposed north Delta intake under Alternative 5 is the same design as those proposed  
40 under Alternative 1A, the potential to affect some fish species through contact with the screens  
41 and/or increased predation around those facilities still exists but to a lesser extent because of four  
42 fewer intakes. Regardless, these effects are considered to be not adverse or beneficial.

1 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
2 in the Delta. There are very few instances where there would be increases, but these are  
3 substantially offset by decreases during other periods. Effects are at a minimum not adverse and less  
4 than significant, with effects being beneficial for some species.

#### 5 **Flows**

6 While San Joaquin River flows are not expected to be affected by Alternative 5, flow changes are  
7 expected in the Sacramento River and its tributaries, as well as within the Sacramento-San Joaquin  
8 Delta. Changes in flow will result from changes in releases from upstream reservoirs, diversions  
9 from the south Delta, and reductions in flows downstream of the proposed north Delta intakes.

10 Alternative 5 includes the USFWS BiOp Fall X2 requirements. Therefore, the area of fall abiotic  
11 habitat for juvenile delta smelt in the open-water areas of the Suisun Bay, Suisun Marsh, and west  
12 Delta subregions would be similar to NAA under Alternative 5, although habitat restoration has the  
13 potential to increase suitable areas of spawning and rearing habitat and is intended to supplement  
14 food production and export to other rearing areas. Alternative 5 is not expected to substantially  
15 affect delta smelt migration conditions.

16 Decreased spring outflows under Alternative 5 have the potential to contribute to decreases in  
17 longfin smelt abundance from reduced larval transport flows and spring habitat quantity and quality  
18 for larval and early juvenile longfin smelt in the Suisun Marsh and west Delta subregions. Modeling  
19 results based on Kimmerer et al. (2009) indicate that relative longfin smelt abundance averaged  
20 across all years would be similar under Alternative 5, compared to NAA. When analyzing individual  
21 water year types, longfin smelt abundances are 10-11% lower in critical years, and 7-9% lower in  
22 above normal water years compared to NAA. However, these analyses do not account for potential  
23 changes in spawning or rearing conditions related to non-operational components of Alternative 5,  
24 including habitat restoration.

25 With regard to salmonids, several issues were identified as described below with some of them  
26 resulting in adverse and/or significant effects. For example, Sacramento River attraction flows for  
27 migrating adult salmonids would be slightly lower from operations of the north Delta diversion  
28 under Alternative 5, but not to an adverse level. Winter-run Chinook salmon would be affected by  
29 reduced spawning and egg incubation habitat (higher egg mortality) and reduced extent and quality  
30 of fry and juvenile rearing habitat as a result of reduced flows, but not to an adverse level. While  
31 operation of the NDD intake could affect winter-run Chinook salmon migration conditions, the  
32 magnitude of effects is uncertain, and additional modeling assessments are needed to verify that no  
33 adverse effects are reasonably likely to occur.

34 Similar flow reductions would reduce spawning, egg incubation, and migration habitat for spring-  
35 run Chinook salmon, but the magnitude of effects is uncertain. Further evaluations would be needed  
36 to confirm that adverse and/or significant effects are not reasonably likely to occur. Flows in the  
37 American, Stanislaus, Mokelumne, and San Joaquin Rivers would be lower than flows under the  
38 CEQA baseline, which would adversely and significantly reduce migration habitat conditions for fall-  
39 /late fall-run Chinook salmon.

40 Steelhead rearing would be adversely affected under Alternative 5. Compared to Existing  
41 Conditions, the quantity and quality of rearing habitat would be substantially reduced due to  
42 decreases in flow during the summer months and in drier year types in the Feather River and  
43 American River. While there are some benefits to increased flows in some months and water years

1 types they are not of sufficient magnitude to offset the negative effects in other months. Alternative  
2 5 would also affect steelhead migration conditions, relative to NAA, although the magnitude of  
3 effects is uncertain. Additional modeling will be needed to determine adverse effects are reasonably  
4 likely to occur.

5 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
6 the Yolo Bypass provide substantial benefits to Sacramento splittail, primarily with regard to  
7 rearing and migration conditions.

8 Alternative 5 would result in similar effects for green and white sturgeon as those described for  
9 Alternative 1A. Alternative 5 would reduce flows and increase water temperatures, resulting in  
10 increased egg mortality, and reduced rearing and migration habitat. However, the mechanisms  
11 behind the observed correlation between sturgeon year class strength and Delta outflow remain  
12 uncertain, but will be addressed through targeted research and monitoring conducted in the years  
13 leading up to the initiation of north Delta facilities operations. These targeted investigations are  
14 expected to identify the primary mechanisms that drive sturgeon year-class strength, and the final  
15 determination of the overall effects of Alternative 5 relative to NAA. The migration effects would be  
16 less than significant, relative to Existing Conditions.

17 Alternative 5 would affect spawning and egg incubation habitat for Pacific lamprey as a result of  
18 increased water temperatures on the Feather River and redd dewatering in the Sacramento and  
19 American rivers. Flow reductions on several waterways, including the American River at the  
20 Sacramento River confluence and in the Trinity River, when compared to Existing Conditions, would  
21 have an effect on lamprey rearing and migration habitat. While these flow changes as compared to  
22 Existing Conditions would be substantial, they would not result in a significant impact on lamprey  
23 species because the differences are primarily the result of climate change, sea level rise and future  
24 water demand and not attributable to the alternative.

25 As evidenced by this summary, some changes in flow under Alternative 5 are adverse to fish species.  
26 Alternative 5 also includes the same conservation measures as Alternative 1A. When the flow and  
27 habitat restoration measures are considered together, many of the effects of Alternative 5 measures  
28 are beneficial or not adverse and/or less than significant. However, several effects resulting from  
29 changes in flows upstream of the Delta remain adverse and/or significant and unavoidable.  
30 However, Alternative 5 includes adaptive management processes that include targeted  
31 investigations to identify appropriate mitigation measures to reduce the severity of effects, although  
32 such reductions would not necessarily result in a not adverse or less than significant determination.  
33 Summary Table 11-5-SUM1 presents the results of the flow related effects on fish.

1 **Table 11-5-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	NA/LTS	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	NA/LTS		ND/LTS (combined)	
Winter-Run Chinook salmon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Spring-Run Chinook salmon	B/LTS	ND/LTS	NA/LTS	ND/LTS
Fall-Run/Late Fall-Run Chinook salmon	B/LTS	NA/LTS	NA/LTS	A/S
Steelhead	NA/LTS	NA/LTS	A/SU	ND/LTS
Sacramento splittail	NA/LTS	NA/LTS	B/B	B/B
Green sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
White sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	A/SU	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 5 is the same as Alternative 1A except that it  
5 includes only 25,000 acres of tidal natural community restoration (CM4) rather than the 65,000  
6 acres of restoration in Alternative 1A. Consequently, all of the effects associated with Alternative 5  
7 are the same as Alternative 1A except for those associated with the smaller amount of tidal natural  
8 community habitat creation or the smaller amount of habitat itself. The effects associated with the  
9 smaller amount of habitat creation and the smaller amount of habitat are summarized below. For a  
10 summary discussion of the effects of other restoration measures see the complete summary under  
11 Alternative 1A.

12 ***Effects of Construction of Restoration Measures***

13 The types of effects related to construction of restoration measures for Alternative 5 would be the  
14 same as those described for Alternative 1A. The area of potential effects of restoration construction  
15 activities under Alternative 5 would be less than that described for Alternative 1A due to the smaller  
16 amount of tidal natural community restoration. However, the discussion under Alternative 1A still  
17 applies because the same in-water construction window, lack of impact pile driving, and  
18 implementation of Appendix 3B, *Environmental Commitments* would still occur. These measures  
19 would avoid or minimize any adverse or significant effects. As a result, the effects of construction of  
20 restoration measures are not adverse and are less than significant for covered and non-covered fish  
21 species.

22 ***Contaminants Associated with Restoration Measures***

23 The types of effects related to contaminants from construction of restoration measures for  
24 Alternative 5 would be the same as those summarized for Alternative 1A. The area of potential

1 effects of restoration construction activities under Alternative 5 would be smaller than that  
 2 described for Alternative 1A due to the smaller amount of tidal natural community habitat  
 3 enhancement. However, the discussion under Alternative 1A still applies and the effects would be  
 4 the same. Contaminants associated with restoration measures would not be adverse and are less  
 5 than significant for covered and non-covered fish species.

## 6 ***Restored Habitat Conditions***

### 7 **CM4 Tidal Natural Community Restoration**

8 The effects under Alternative 5 of restored habitat conditions for CM2 *Yolo Bypass Fisheries*  
 9 *Enhancement*, CM5 *Seasonally Inundated Floodplain Restoration*, CM6 *Channel Margin Enhancement*,  
 10 CM7 *Riparian Natural Community Restoration*, and CM10 *Nontidal Marsh Restoration* would be the  
 11 same as summarized under Alternative 1A. The types of effects of restored habitat for CM4 *Tidal*  
 12 *Natural community Restoration* would also be the same as summarized for Alternative 1A except  
 13 that a smaller amount of habitat would be created. For CM4 *Tidal Natural Community Restoration*  
 14 only 25,000 acres would be created rather than 65,000 acres. This reduction in habitat amount  
 15 would provide proportionally less benefit than that described under Alternative 1A but it would still  
 16 be beneficial. Consequently, the effects would be the same as described under Alternative 1A. As  
 17 summarized there, the overall effects would be beneficial for all covered and non-covered fish  
 18 species.

### 19 **Other Conservation Measures (CM12–CM19 and CM21)**

20 With respect to other conservation measures, Alternative 5 is the same as Alternative 1A as  
 21 described above under Other Conservation Measures (CM12–CM19 and CM21). Consequently, all of  
 22 the effects associated with Alternative 5 are the same as Alternative 1A except for those associated  
 23 with smaller amounts of habitat creation or the smaller amount of habitat itself. Therefore, the only  
 24 conservation measure specifically addressed for Alternative 5 is CM12 *Methylmercury Management*.  
 25 The effects associated with the smaller amount of habitat creation and the smaller amount of habitat  
 26 are summarized below. For a summary discussion of the effects of other conservation measures see  
 27 the complete summary under Alternative 1A.

#### 28 ***Methylmercury Management (CM12)***

29 The effects of CM12 *Methylmercury Management* would be the same as described under Alternative  
 30 1A except that they would be applied over a smaller area. Consequently, these effects would not be  
 31 adverse and are less than significant.

### 32 **Comparison of Alternative 5 to Alternative 4 (Proposed Project)**

33 Alternative 5 would convey up to 3,000 cfs of water from one north Delta screened intake on the  
 34 east bank of the Sacramento River near Clarksburg, and pipeline/tunnel conveyance facilities to the  
 35 south Delta. While Alternative 4 would have a similar conveyance structure, it would have two  
 36 additional intake (three total), with a total maximum capacity of 9,000 cfs. Alternative 5 would  
 37 follow Operational Scenario C, while Alternative 4 would follow Operational Scenario H, resulting in  
 38 different patterns of water withdrawals from the north Delta, and potentially different effects on  
 39 water quality and aquatic habitat conditions in the Plan Area. As fully described in Chapter 3,  
 40 *Description of Alternatives*, Alternative 4 operations incorporate a decision tree process that results

1 in four potential operational sub-scenarios, depending on the outcome of the decision tree process  
2 for spring outflow and Fall X2 operations.

### 3 **Construction and Maintenance of CM1**

4 The potential for construction and maintenance activities to affect the covered fish species would  
5 typically be proportional to the number of north Delta intakes constructed, and the total area of  
6 habitat affected. As a result, Alternative 5 would have a much lower potential for effects than  
7 Alternative 4 because it includes the construction of only one intake, which is two fewer than  
8 Alternative 4. This would result in up to about 11.2 acres (69%) less in-water area affected by  
9 construction activities than for Alternative 4. In addition, the total length of shoreline permanently  
10 replaced by the intake (up to about 2,050 feet) would be 68% less than Alternative 4 (see Table 11-  
11 1A-SUM1). In addition to the effects of intake construction, Alternative 5 would require about 73%  
12 less dredging (4.7 acres) to re-contour the streambed adjacent to the intake. However, both  
13 alternatives include a tunnel/pipeline conveyance system, and six barge landings to support tunnel  
14 construction. Each barge landing would include in-water and over-water structures, occupying  
15 approximately 15,000 square feet of nearshore habitat.

16 As discussed above, in-water and nearshore construction activities have the potential to cause  
17 adverse effects on covered species, although these adverse effects would be effectively avoided and  
18 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
19 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
20 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
21 that have limited use by the covered species, adhering to the approved in-water work windows, and  
22 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
23 the effects would not limit overall population productivity.

24 In summary, construction and maintenance activities would result in limited temporary and  
25 permanent effects on the covered fish species and their habitat. While these effects would vary by  
26 species and species life stages, the implementation of environmental commitments and BMPs (see  
27 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
28 not adverse and less than significant. The implementation of habitat restoration activities,  
29 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
30 the intake sites.

### 31 **Water Operations of CM1**

32 Water operations under Alternative 5 differ from Alternative 4 in a few ways. Alternative 5 utilizes  
33 one intake in the north Delta that can convey up to 3,000 cfs while Alternative 4 utilizes three  
34 intakes and can only convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*, average annual  
35 exports under Alternative 5 are anticipated to be 4786 TAF while Alternative 4 has anticipated  
36 exports ranging from 4,414 (under H4) to 5,255 (under H1). Changes in anticipated long-term  
37 average annual Delta outflow under Alternative 4 also vary between the operational scenarios (H1-  
38 H4). While the average annual outflows would be less for two of the Alternative 4 operational  
39 scenarios compared to Alternative 5 (166 and 515 TAF less for H1 and H3, respectively), operational  
40 scenario H2 would result in about 4 TAF higher and operational scenario H4 would result in about  
41 344 TAF higher average annual outflow. Alternative 5 would also result in different annual average  
42 outflow than Existing Conditions (about 400 TAF greater), but about 349 TAF less than NAA.

1 There are various benefits to entrainment and migration for some species under both Alternatives,  
 2 with Alternative 5 having entrainment benefits for four species while Alternative 4 is beneficial for  
 3 two species. Alternative 4 provides somewhat greater beneficial effects on rearing for Delta smelt.  
 4 The substantive difference is that Alternative 5 results in adverse effects/significant and  
 5 unavoidable impacts to Pacific lamprey spawning, fall-run/late-fall run salmon, and steelhead  
 6 rearing, and fall-run/late-fall run salmon, whereas Alternative 4 doesn't result in any adverse  
 7 effects/significant and unavoidable impacts.

#### 8 **Restoration Measures (CM2, CM4–CM7, and CM10)**

9 With respect to restoration measures, Alternative 5 would be the same as Alternative 4 except that it  
 10 includes only 25,000 acres of tidal natural community restoration (CM4) rather than the 65,000  
 11 acres of restoration in Alternative 4. Consequently, all of the effects associated with Alternative 5 are  
 12 the same as Alternative 4 except for the reduced amount of tidal natural community habitat restored  
 13 or the smaller amount of habitat itself. The effects associated with these differences, is the same as  
 14 described above in the comparison of Alternative 5 with Alternative 1A, which is expected to result  
 15 in fewer benefits to a number of covered fish species.

#### 16 **Other Conservation Measures (CM12–CM19 and CM21)**

17 With respect to other conservation measures, Alternative 5 would be the same as Alternative 4.  
 18 Consequently, the effects associated with these other conservation measures would also be the same  
 19 for both alternatives.

### 20 **11.0.2.10 Alternative 6A—Summary of Effects**

#### 21 **Overview**

22 While Alternative 6A uses the same five intakes as Alternative 1A, it is substantially different with  
 23 respect to operations and flow. Alternative 6 uses Operational Scenario D which would eliminate the  
 24 south Delta intakes. Alternative 6A would still divert up to 15,000 cfs from the Sacramento River, the  
 25 same as Alternative 1A.

26 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
 27 these CMs would be identical to those under Alternative 1A.

#### 28 **Construction and Maintenance of CM1**

29 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
 30 affect the covered fish species would typically be proportional to the number of north Delta intakes  
 31 constructed, and the total area of habitat affected. Alternative 6A includes the same intakes as  
 32 Alternative 1A. Therefore, the total area affected by intake construction would be the same, at about  
 33 28.7 acres (see Table 11-1A-SUM1). Also similar to Alternative 1A, Alternative 6A includes a  
 34 conveyance tunnel and six barge landings.

35 At the Alternative 6A intakes, between 1.2 and 6.9 acres of river area would be isolated behind  
 36 cofferdams, and temporarily or permanently lost. During the in-water construction period, a total of  
 37 up to about 27.3 acres of in-water habitat would be affected by dredging activities, this loss or  
 38 alteration of low-quality spawning, rearing, and migration habitat for covered fish species would be  
 39 the same as Alternative 1A (see Table 11-1A-SUM1). Similarly, the footprint of the intake and  
 40 transition wall structures would result in permanent loss of about 11,900 feet of primarily steep-

1 banked and riprapped shoreline habitat, also the same as Alternative 1A. The barge landings would  
2 include in-water and over-water structures, occupying approximately 15,000 square feet of  
3 shoreline habitat.

4 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
5 potential to cause adverse effects on covered species, although these adverse effects would be  
6 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
7 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
8 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
9 constructing in areas that have limited use by the covered species, adhering to the approved in-  
10 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
11 by construction activities, the effects would not limit overall population productivity.

12 In summary, construction and maintenance activities would result in limited temporary and  
13 permanent effects on the covered fish species or their habitat. While these effects would vary by  
14 species and species life stages, the implementation of environmental commitments and BMPs (see  
15 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
16 not adverse and less than significant. The implementation of habitat restoration activities,  
17 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
18 the intake sites.

### 19 **Water Operations of CM1**

20 The methods and analysis of Alternative 6A are the same as those previously described for  
21 Alternative 1A. Alternative 6 includes the same five intakes utilized in Alternative 1A, but  
22 Alternative 6A uses water Operational Scenario D which eliminates use of the south Delta intakes  
23 (i.e., there is only an isolated north Delta conveyance). While the volume associated with the  
24 conveyance infrastructure is the same, the water operations scenario differs and the effects are  
25 different.

### 26 ***Changes in Exports and Outflow***

27 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
28 Alternative 6A are anticipated to decrease by 1,386 TAF relative to Existing Conditions, and by 683  
29 TAF relative to the No Action Alternative. Because Operational Scenario D eliminates use of the  
30 south Delta intakes, 100% of the exported water will be from the new north Delta intakes. These  
31 changes would increase the proportion of San Joaquin River water flowing throughout the south,  
32 west, and interior Delta, and a corresponding decrease in the proportion of Sacramento River water.

33 Under Alternative 6A, long-term average annual Delta outflow is anticipated to increase 1,383 TAF  
34 relative to Existing Conditions and by 633 TAF relative to the NAA. It is important to note that some  
35 outflow changes under Alternative 6A are greater relative to Existing Conditions because Existing  
36 Conditions do not include operations to meet Fall X2, whereas NAA and Alternative 6A do include  
37 Fall X2.

38 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
39 diverted in February through May and less water diverted June through January), there would be  
40 beneficial, not adverse/less than significant, and adverse/significant and unavoidable  
41 effects/impacts on fish under Alternative 6A. Following is a summary of these effects as they relate  
42 to the key factors of entrainment and flow, which in turn affects fish survival and spawning, rearing,

1 and migration habitat conditions. However, because of reliance on upstream flow, there are more  
2 adverse effects associated with Alternative 6A than Alternative 1A.

### 3 **Entrainment**

4 Similar to Alternative 1A, overall entrainment of numerous species under Alternative 6A would be  
5 substantially less than the levels currently experienced in the Delta. There would be additional  
6 minor benefits from decommissioning of agricultural diversions in restoration areas and  
7 implementation of an alternative intake for the North Bay Aqueduct. There would be beneficial  
8 effects for a number of covered fish species, including delta smelt, longfin smelt, and the salmonid  
9 species, and no adverse effects on other species.

10 Since the proposed north Delta intakes under Alternative 6A are the same design as those proposed  
11 under Alternative 1A, entrainment is expected to be substantially reduced compared to the  
12 entrainment currently occurring at the south Delta facilities, which would be eliminated under  
13 Alternative 6A. However, there is still the potential to affect some fish species through contact with  
14 the screens and/or increased predation around those facilities, which would be similar to  
15 Alternative 1A. As for Alternative 1A, these effects are considered to be not adverse.

16 In summary, entrainment is expected to be substantially reduced compared to the levels currently  
17 experienced by fish in the Delta. Effects are at a minimum not adverse and less than significant, with  
18 effects being beneficial for several species.

### 19 **Flows**

20 The non-utilization of the south Delta facilities will measurably alter the overall flow conditions in  
21 the Delta. Flow changes are expected in the San Joaquin and Sacramento Rivers and tributaries, as  
22 well as within the Sacramento-San Joaquin Delta. Changes in flow will result from changes in  
23 releases from upstream reservoirs, reductions in flows downstream of the proposed north Delta  
24 intakes, and improved OMR flows.

25 The area of fall abiotic habitat for juvenile delta smelt in the open-water areas of the Suisun Bay,  
26 Suisun Marsh, and west Delta subregions would be larger under Alternative 6A than under NAA  
27 conditions, without including potential habitat restoration benefits. Habitat restoration has the  
28 potential to increase spawning and rearing habitat and could supplement food production and  
29 export to rearing areas. However, the overall effects of habitat restoration and the mechanism of Fall  
30 X2 correlation are uncertain and current efforts (FlaSH studies) are underway to better understand  
31 the relationship between Fall Delta outflow, suitable rearing habitat for delta smelt, and delta smelt  
32 abundance. Migration conditions are not expected to change substantially under Alternative 6A.

33 Despite the growing body of evidence that supports the positive correlation between longfin smelt  
34 abundance and spring outflow, the specific timing and amount of outflow needed to conserve longfin  
35 smelt, are generally unknown. Averaged across all water year types, Delta outflow under Alternative  
36 6A would be similar (<10% change) to NAA during the January–June period. Other components of  
37 Alternative 6A have the potential to increase recruitment per unit of flow. These analyses do not  
38 take into account any potential changes in spawning or rearing conditions related to non-  
39 operational components of Alternative 6A, including habitat restoration.

40 With regard to salmonids, several issues were identified with a number of them resulting in adverse  
41 and/or significant effects, although entrainment effects would largely be beneficial. For example,  
42 Sacramento River attraction flows for migrating adult salmonids would be lower due to operations

1 of the north Delta diversions under Alternative 6A. While winter-run Chinook salmon would also be  
2 affected by reduced spawning and egg incubation habitat (higher egg mortality) and reduced extent  
3 and quality of fry and juvenile rearing habitat as a result of reduced flows, these effects would not be  
4 adverse. These effects are also largely the result of climate change, sea level rise, and future water  
5 demand, rather than the alternative.

6 Alternative 6A would however, result in adverse effects on winter-run, spring-run, fall-/late fall-run  
7 Chinook salmon, and steelhead migration conditions. Although the implementation of conservation  
8 and mitigation measures would reduce the severity of such effects, the result could still be adverse  
9 and significant. While these same flow reductions would typically not reduce spawning, rearing, and  
10 migration habitat conditions to an adverse level for spring-run or fall-run/late fall-run Chinook  
11 salmon in upstream areas, through-Delta migration habitat conditions would be adversely affected.

12 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
13 the Yolo Bypass provide substantial benefits to Sacramento splittail, primarily with regard to  
14 spawning and migration.

15 Alternative 6A would result in similar effects for sturgeon as those described for Alternative 1A.  
16 Alternative 6A would reduce flows and increase water temperatures, resulting in increased egg  
17 mortality as well as reduced rearing and migration habitat. However, the uncertainties regarding the  
18 mechanisms driving the observed correlation between Delta outflow and sturgeon year class  
19 strength will be addressed through targeted research and monitoring conducted in the years leading  
20 to the initiation of north Delta facilities operations. These targeted investigations are expected to  
21 identify the primary mechanisms that drive sturgeon year-class strength, and the final  
22 determination of the overall effects of Alternative 6A relative to NAA. However, the effects are  
23 considered less than significant relative to existing conditions.

24 Alternative 6A would affect spawning and egg incubation habitat for lamprey species as a result of  
25 increased water temperatures on the Feather River and redd dewatering in the Sacramento and  
26 American rivers. Flow reductions on several waterways, including the Sacramento, Trinity, and  
27 American rivers, when compared to Existing Conditions, would affect lamprey spawning, rearing  
28 and migration habitat. However, these effects are primarily the result of climate change, sea level  
29 rise, and future water demand, and not attributable to the alternative. Thus, the overall effects on  
30 lamprey would not be significant or adverse.

31 As evidenced by this summary, changes in flow under Alternative 6A are adverse to some fish  
32 species. Alternative 6A also includes the same conservation measures as Alternative 1A. When the  
33 flow and habitat restoration measures are considered together, many of the effects of Alternative 6A  
34 measures are beneficial or not adverse and/or less than significant. However, several effects  
35 resulting from changes in flows upstream of the Delta remain adverse and/or significant and  
36 unavoidable for most species. While adaptive management mitigation measures would be  
37 implemented to reduce the severity of effects, the results could still be adverse and/or significant.  
38 Summary Table 11-6A-SUM1 presents the results of the flow related effects on fish.

1 **Table 11-6A-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	B/B	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	B/B		ND/B (combined)	
Winter-Run Chinook salmon	B/B	NA/LTS	NA/LTS	A/SU
Spring-Run Chinook salmon	B/B	NA/LTS	NA/LTS	A/SU
Fall-Run/Late Fall-Run Chinook salmon	B/B	NA/LTS	NA/LTS	A/SU
Steelhead	B/LTS	NA/LTS	NA/LTS	A/SU
Sacramento splittail	NA/LTS	NA/LTS	NA/LTS	NA/LTS
Green sturgeon	B/LTS	NA/LTS	NA/LTS	ND/LTS
White sturgeon	B/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 6A is the same as Alternative 1A. Consequently, all  
5 the effects associated with restoration measures under Alternative 6A are the same as those  
6 described above under the Alternative 1A summary.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 With respect to other conservation measures, Alternative 6A is the same as Alternative 1A.  
9 Consequently, all the effects associated with other conservation measures under Alternative 6A are  
10 the same as those described above under the Alternative 1A summary.

11 **Comparison of Alternative 6A to Alternative 4 (Proposed Project)**

12 Alternative 6A would convey up to 15,000 cfs of water from the north Delta to the south Delta  
13 through pipelines/tunnels via five screened intakes on the east bank of the Sacramento River  
14 between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). While Alternative 4 would also  
15 consist of constructing similar intake and conveyance structures, in this same area of the river, it  
16 would include only three intakes, with a conveyance capacity of up to 9,000 cfs. Alternative 6A  
17 would also have a different operations scenario (Scenario D), with an isolated conveyance process,  
18 compared to Alternative 4 (Scenario H) and dual conveyance operations.

19 **Construction and Maintenance of CM1**

20 The potential for construction and maintenance activities to affect the covered fish species would  
21 typically be proportional to the number of north Delta intakes constructed, and the total area of  
22 habitat affected. As a result, Alternative 6A would have a greater potential for effects than

1 Alternative 4 because it includes the construction of two additional intakes (five), along with the  
2 associated increase in streambed dredging. The potential effects of Alternative 6A would be similar  
3 to the effects described above for Alternative 1A, (see Table 11-1A-SUM1).

4 As discussed above, in-water and nearshore construction activities have the potential to cause  
5 adverse effects on covered species, although these adverse effects would be effectively avoided and  
6 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
7 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
8 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
9 that have limited use by the covered species, adhering to the approved in-water work windows, and  
10 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
11 the effects would not limit overall population productivity.

12 In summary, construction and maintenance activities would result in limited temporary and  
13 permanent effects on the covered fish species and their habitat. While these effects would vary by  
14 species and species life stages, the implementation of environmental commitments and BMPs (see  
15 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
16 not adverse and less than significant. The implementation of habitat restoration activities,  
17 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
18 the intake sites.

### 19 **Water Operations of CM1**

20 Water operations under Alternative 6A differ from Alternative 4 in several ways. Alternative 6  
21 includes five intakes in the north Delta to convey up to 15,000 cfs, while Alternative 4 utilizes three  
22 intakes, and can only convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*, average  
23 annual exports under Alternative 6 are anticipated to be 3,758 TAF, which is substantially less than  
24 anticipated exports under all four operational scenarios for Alternative 4 (4,414 to 5,255 TAF).  
25 Average annual exports under Alternative 6 would also be substantially less than Existing  
26 Conditions (5,144 TAF), as well as NAA (4,441 TAF).

27 Changes in anticipated long-term average annual Delta outflow under Alternative 4 also vary  
28 between the operational scenarios (H1–H4). The average annual outflows would be greater for  
29 Alternative 6A than all the Alternative 4 operational scenarios (between 639 and 1,498 TAF  
30 greater). Alternative 6A would result in greater annual average outflow (about 1,383 TAF) than  
31 Existing Conditions, and about 634 TAF more than NAA.

32 There are various benefits to entrainment, rearing, and migration conditions for some species under  
33 both alternatives. While Alternative 6A results in beneficial effects salmonid entrainment,  
34 Alternative 4 results would typically not be adverse or less than significant, although beneficial  
35 effects would occur for some of these same species.

### 36 **Restoration Measures (CM2, CM4–CM7, and CM10)**

37 With respect to restoration measures, Alternative 6A would be the same as Alternative 4.  
38 Consequently, the effects of these measures would also be the same.

## 1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 With respect to other conservation measures, Alternative 6A would be the same as Alternative 4.  
3 Consequently, the effects associated with these other conservation measures would also be the same  
4 for both alternatives.

### 5 **11.0.2.11 Alternative 6B—Summary of Effects**

#### 6 **Overview**

7 Alternative 6B includes the same five intakes on the Sacramento River, and the same culvert and  
8 tunnel siphons, as Alternatives 1A and 1B. Alternative 6B also has an east-side alignment surface  
9 canal conveyance like the one included in Alternatives 1B and 2B. Alternative 6B differs from  
10 Alternative 1B because it does not include the south Delta intakes. However, because no  
11 construction impacts on the aquatic environment are associated with the south Delta intakes,  
12 construction impacts would be the same as those under Alternative 1B and Alternative 2B. In  
13 addition, only one barge landing would be constructed under Alternative 6B compared to six under  
14 Alternative 1A.

15 Water supply and conveyance operations would follow the guidelines described as Scenario D.  
16 Alternative 6B has the same diversion and conveyance operations as Alternative 6A; consequently,  
17 the analysis under Alternative 6A is applicable to Alternative 6B.

18 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
19 these CMs would be identical to those under Alternatives 6A and 1A.

#### 20 **Construction and Maintenance of CM1**

21 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
22 affect the covered fish species would typically be proportional to the number of north Delta intakes  
23 constructed, and the total area of habitat affected. Alternative 6B includes the same intakes as  
24 Alternative 1A. Therefore, the total area affected by intake construction would be the same, at about  
25 28.7 acres (see Table 11-1A-SUM1). Unlike Alternative 1A, Alternative 6B includes an east side  
26 conveyance canal, instead of a tunnel and only one barge landing.

27 At the Alternative 6B intakes, between 1.2 and 6.9 acres of river area would be isolated behind  
28 cofferdams, and temporarily or permanently lost. During the in-water construction period, a total of  
29 up to about 27.3 acres of in-water habitat would be affected by dredging activities, this loss or  
30 alteration of low-quality spawning, rearing, and migration habitat for covered fish species would be  
31 the same as Alternative 1A (see Table 11-1A-SUM1). Similarly, the footprint of the intake and  
32 transition wall structures would result in permanent loss of about 11,900 feet of primarily steep-  
33 banked and riprapped shoreline habitat, also the same as Alternative 1A. The barge landing would  
34 include in-water and over-water structures, occupying approximately 15,000 square feet of  
35 shoreline habitat.

36 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
37 potential to cause adverse effects on covered species, although these adverse effects would be  
38 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
39 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
40 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
41 constructing in areas that have limited use by the covered species, adhering to the approved in-

1 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
2 by construction activities, the effects would not limit overall population productivity.

3 In summary, construction and maintenance activities would result in limited temporary and  
4 permanent effects on the covered fish species or their habitat. While these effects would vary by  
5 species and species life stages, the implementation of environmental commitments and BMPs (see  
6 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
7 not adverse and less than significant. The implementation of habitat restoration activities,  
8 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
9 the intake sites.

#### 10 **Water Operations of CM1**

11 With respect to water operations of CM1, Alternative 6B is the same as Alternative 6A.  
12 Consequently, all the effects associated with water operations of CM1 under Alternative 6B are the  
13 same as those described above under the Alternative 6A summary.

#### 14 **Restoration Measures (CM2, CM4–CM7, and CM10)**

15 With respect to restoration measures, Alternative 6B is the same as Alternatives 6A and 1A.  
16 Consequently, all the effects associated with restoration measures under Alternative 6B are the  
17 same as those described above under the Alternative 1A summary.

#### 18 **Other Conservation Measures (CM12–CM19 and CM21)**

19 With respect to other conservation measures, Alternative 6B is the same as Alternatives 6A and 1A.  
20 Consequently, all the effects associated with other conservation measures under Alternative 6B are  
21 the same as those described above under the Alternative 1A summary.

#### 22 **Comparison of Alternative 6B to Alternative 4 (Proposed Project)**

23 Alternative 6B would convey up to 15,000 cfs of water from the north Delta to the south Delta  
24 through a surface canal, from five screened intakes on the east bank of the Sacramento River  
25 between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). While Alternative 4 would also  
26 consist of constructing similar intake and conveyance structures, in this area of the river, it would  
27 include only three intakes, with a conveyance capacity of up to 9,000 cfs. Alternative 6B would also  
28 have a different operations scenario (Scenario D), with an isolated conveyance process, compared to  
29 Alternative 4 (Scenario H) and dual conveyance operations. As described above, Scenario H  
30 incorporates a decision tree process that results in four potential operational sub-scenarios,  
31 depending on the outcome of the decision tree process for spring outflow and Fall X2 operations.

#### 32 **Construction and Maintenance of CM1**

33 The potential for construction and maintenance activities to affect the covered fish species would  
34 typically be proportional to the number of north Delta intakes constructed, and the total area of  
35 habitat affected. As a result, Alternative 6B would have a greater potential for effects than  
36 Alternative 4 because it includes the construction of two additional intakes (five total), along with  
37 the associated increase in streambed dredging. The potential effects of Alternative 6B would be  
38 similar to the effects described above for Alternatives 1A and 1B, (see Table 11-1A-SUM1).

1 As discussed above, in-water and nearshore construction activities have the potential to cause  
2 adverse effects on covered species, although these adverse effects would be effectively avoided and  
3 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
4 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
5 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
6 that have limited use by the covered species, adhering to the approved in-water work windows, and  
7 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
8 the effects would not limit overall population productivity.

9 In summary, construction and maintenance activities would result in limited temporary and  
10 permanent effects on the covered fish species and their habitat. While these effects would vary by  
11 species and species life stages, the implementation of environmental commitments and BMPs (see  
12 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
13 not adverse and less than significant. The implementation of habitat restoration activities,  
14 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
15 the intake sites.

#### 16 **Water Operations of CM1**

17 With respect to water operations, Alternative 6B would be the same as Alternative 6A. Please refer  
18 to the comparison of Alternative 6A to Alternative 4.

#### 19 **Restoration Measures (CM2, CM4–CM7, and CM10)**

20 With respect to restoration measures, Alternative 6B would be the same as Alternative 4.  
21 Consequently, the effects of these measures would also be the same.

#### 22 **Other Conservation Measures (CM12–CM19 and CM21)**

23 With respect to other conservation measures, Alternative 6B would be the same as Alternative 4.  
24 Consequently, the effects associated with these other conservation measures would also be the same  
25 for both alternatives.

### 26 **11.0.2.12 Alternative 6C—Summary of Effects**

#### 27 **Overview**

28 Construction impacts from Alternative 6C would be the same as those discussed for Alternative 1C.  
29 Like Alternative 1C, Alternative 6C would convey water from five fish-screened intakes in the  
30 Sacramento River between Clarksburg and Walnut Grove in the north Delta through a tunnel and  
31 two large canal segments to a new Byron Tract Forebay adjacent to CCF in the south Delta. However,  
32 like Alternatives 6A and 6B, Alternative 6C would be an isolated conveyance, no longer involving  
33 operation of the existing SWP and CVP south Delta export facilities for CCF and Jones Pumping Plant.  
34 Other than the isolated conveyance and the culvert siphons, and number of barge landings, the  
35 physical and structural components would be similar to those under Alternative 1C.

36 Water supply and conveyance operations would follow the guidelines described as Scenario D.  
37 Alternative 6C has the same diversion and conveyance operations as Alternative 6A; consequently,  
38 the analysis under Alternative 6A is applicable to Alternative 6C.

1 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
2 these CMs would be identical to those under Alternatives 6A and 1A.

### 3 **Construction and Maintenance of CM1**

4 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
5 affect the covered fish species would typically be proportional to the number of north Delta intakes  
6 constructed, and the total area of habitat affected. Alternative 6C includes the same number of  
7 intakes (five) and the same intake locations as Alternative 1C and 2C. Therefore, the total area  
8 affected by intake construction would be similar to these other alternatives. These alternatives  
9 would have similar overall effects as Alternative 1A, which also has the same number of intakes,  
10 although the intakes are on the opposite (west) side of the river (see Table 11-1A-SUM1). Unlike  
11 Alternative 1A, Alternative 6C includes a west side conveyance canal, and two barge landings,  
12 although most of the in-water construction activities would be about the same.

13 At each Alternative 6C intake, between 1.4 and 7.8 acres of river area would be isolated behind  
14 cofferdams, and temporarily or permanently lost, for an estimated maximum total of 32.7 acres. This  
15 is about 14% greater than Alternative 1A. During the in-water construction period, a total of up to  
16 about 20.3 acres of in-water habitat would be affected by dredging activities, this loss or alteration  
17 of low-quality spawning, rearing, and migration habitat for covered fish species would be about 25%  
18 less than for Alternative 1A (see Table 11-1A-SUM1). Likewise, the footprint of the intake and  
19 transition wall structures would result in permanent loss of about 10,100 feet of primarily steep-  
20 banked and riprapped shoreline habitat, or about 15% less than for Alternative 1A. The barge  
21 landings would include in-water and over-water structures, occupying approximately 15,000 square  
22 feet of shoreline habitat, although this would be 67% lower than for Alternative 1A.

23 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
24 potential to cause adverse effects on covered species, although these adverse effects would be  
25 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
26 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures  
27 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
28 constructing in areas that have limited use by the covered species, adhering to the approved in-  
29 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
30 by construction activities, the effects would not limit overall population productivity.

31 In summary, construction and maintenance activities would result in limited temporary and  
32 permanent effects on the covered fish species or their habitat. While these effects would vary by  
33 species and species life stages, the implementation of environmental commitments and BMPs (see  
34 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
35 not adverse and less than significant. The implementation of habitat restoration activities,  
36 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
37 the intake sites.

### 38 **Water Operations of CM1**

39 With respect to water operations of CM1, Alternative 6C is the same as Alternative 6A. Consequently,  
40 all the effects associated with water operations of CM1 under Alternative 6C are the same as those  
41 described above under the Alternative 6A summary.

1       **Restoration Measures (CM2, CM4–CM7, and CM10)**

2       With respect to restoration measures, Alternative 6C is the same as Alternatives 6A and 1A.  
3       Consequently, all the effects associated with restoration measures under Alternative 6C are the  
4       same as those described above under the Alternative 1A summary.

5       **Other Conservation Measures (CM12–CM19 and CM21)**

6       With respect to other conservation measures, Alternative 6C is the same as Alternatives 6A and 1A.  
7       Consequently, all the effects associated with other conservation measures under Alternative 6C are  
8       the same as those described above under the Alternative 1A summary.

9       **Comparison of Alternative 6C to Alternative 4 (Proposed Project)**

10       Alternative 6C would convey up to 15,000 cfs of water from the north Delta to the south Delta  
11       through a surface canal on the west side of the Sacramento River, from five screened intakes  
12       constructed between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). While Alternative 4  
13       would construct similar intake facilities in this portion of the river, it would include only three  
14       intakes (with up to 9,000 cfs combined capacity), and the intakes would be on the east side of the  
15       river. While Alternative 4 would tunnel under a number of waterways along the conveyance route,  
16       the surface canal for Alternative 6C would use culvert siphons to pass under nine waterways, each  
17       requiring in-water construction. Alternative 2C would also have two barge landings and 16 bridge  
18       crossings compared to six barge landings and no bridge crossings for Alternative 4.

19       In addition to these construction differences, Alternative 6C includes a different operations scenario  
20       (Scenario D) than Alternative 4 (Scenario H). Scenario H incorporates a decision tree process that  
21       results in four potential operational sub-scenarios, depending on the outcome of the decision tree  
22       process for spring outflow and Fall X2 operations.

23       **Construction and Maintenance of CM1**

24       The potential for construction and maintenance activities to affect the covered fish species would  
25       typically be proportional to the number of north Delta intakes constructed, and the total area of  
26       habitat affected. As a result, Alternative 6C would have substantially greater potential for effects  
27       than Alternative 4, because it includes the construction of two additional intakes (five total). The  
28       additional intakes would also require dredging to re-contour the adjacent streambed. These effects  
29       would be the similar to those described above for Alternative 1A and 1C (see Table 11-1A-SUM1).

30       As discussed above, in-water and nearshore construction activities have the potential to cause  
31       adverse effects on covered species, although these adverse effects would be effectively avoided and  
32       minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
33       *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
34       AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
35       that have limited use by the covered species, adhering to the approved in-water work windows, and  
36       activity-specific timing restrictions. While individual fish may be affected by construction activities,  
37       the effects would not limit overall population productivity.

38       In summary, construction and maintenance activities would result in limited temporary and  
39       permanent effects on the covered fish species and their habitat. While these effects would vary by  
40       species and species life stages, the implementation of environmental commitments and BMPs (see  
41       Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be

1 not adverse and less than significant. The implementation of habitat restoration activities,  
 2 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
 3 the intake sites.

#### 4 **Water Operations of CM1**

5 With respect to water operations, Alternative 6C would be the same as Alternative 6A. Please refer  
 6 to the comparison of Alternative 6A to Alternative 4.

#### 7 **Restoration Measures (CM2, CM4–CM7, and CM10)**

8 With respect to restoration measures, Alternative 6C would be the same as Alternative 4.  
 9 Consequently, the effects of these measures would also be the same.

#### 10 **Other Conservation Measures (CM12–CM19 and CM21)**

11 With respect to other conservation measures, Alternative 6C would be the same as Alternative 4.  
 12 Consequently, the effects associated with these other conservation measures would also be the same  
 13 for both alternatives.

### 14 **11.0.2.13 Alternative 7—Summary of Effects**

#### 15 **Overview**

16 Alternative 7 is the same as Alternative 1A except that it involves Intakes 2, 3, and 5 instead of  
 17 Intakes 1, 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would  
 18 divert up to 15,000 cfs and uses Operational Scenario A, Alternative 7 would divert up to 9,000 cfs in  
 19 the north Delta and uses Operational Scenario E. Alternative 7 has Enhanced Aquatic Conservation  
 20 which would enhance 20,000 acres of floodplain habitat versus 10,000 acres for Alternative 1A. A  
 21 total of 40 linear miles of channel margin habitat would be enhanced under Alternative 7 instead of  
 22 20 linear miles for Alternative 1A. Alternative 7 has the same six barge facilities as Alternative 1A.

23 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
 24 these CMs would be identical to those under Alternative 1A.

#### 25 **Construction and Maintenance of CM1**

26 Alternative 7 includes the same construction and maintenance elements as described above for  
 27 Alternative 1A, except that it involves only three intakes (Intakes 2, 3, and 5) instead of five intakes  
 28 (Intakes 1, 2, 3, 4, and 5) for Alternative 1A (see Table 11-1A-SUM1). Thus, the amount of  
 29 permanently displaced shoreline habitat (7,450 linear feet), from the intakes and transition wall  
 30 structures, would be about 37% less than for Alternative 1A (11,900 feet). The overall footprint of  
 31 the three intakes would be about 56% smaller (5.1 acres) than for Alternative 1A (11.7 acres), and  
 32 the amount of dredging and channel shaping would be about 38% less for Alternative 7 (17 acres)  
 33 than for Alternative 1A (27.3 acres). Despite these differences in construction area, there would be  
 34 no substantial difference in effects at the barge landing sites, as Alternative 7 includes the same six  
 35 barge facilities as Alternative 1A.

36 In addition to the smaller construction footprint, and fewer potential effects on the covered fish  
 37 species, Alternative 7 would enhance 100% more floodplain habitat (20,000 acres) and channel

1 margin habitat (40 linear miles) than Alternative 1A (10,000 acres and 20 linear miles,  
2 respectively).

3 The smaller construction area would result in a substantially lower potential for effects on the  
4 covered fish species, due to proportionally less pile driving, dredging, and overall in-water  
5 construction activities. The fewer intakes would also result in a substantial reduction in the  
6 potential to trap or strand fish within the cofferdams, and reduce the risks associated with rescuing  
7 these fish. Despite the substantial reduction in pile driving activity, the pile driving effects could still  
8 be adverse, although the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
9 effectively avoid and minimize adverse effects from impact pile driving.

10 The reduced construction activities would also have less potential for water quality degradation  
11 from increased turbidity, inadvertent spills of hazardous materials, and disruption of contaminated  
12 sediments. In addition, these potential effects would be effectively avoided and minimized by  
13 isolating much of the in-water work inside cofferdams, constructing in areas that have limited use  
14 by the covered species, adhering to the approved in-water work windows, activity-specific timing  
15 restrictions, and by implementing environmental commitments and BMPs (see Appendix 3B,  
16 *Environmental Commitments*). These environmental commitments would be expected to protect  
17 covered fish species from adverse water quality effects resulting from project construction. These  
18 same commitments would also offset potential effects of periodic maintenance activities, which  
19 would also be proportionally reduced compared to Alternative 1A.

20 The fewer in-water structures constructed under Alternative 7, compared to Alternative 1A, would  
21 likely result in proportionally less potential predator habitat, although the overall effect on  
22 predation rates would be negligible.

23 As the construction and maintenance activities would be similar to those discussed for Alternative  
24 1A, the types of effects on the covered species and non-covered species of primary management  
25 concern would also be similar, although the magnitude of effects would be proportionally less. In  
26 addition, the increased habitat enhancement provided by Alternative 7 would result in greater  
27 benefits to the covered species than Alternative 1A. Therefore, the construction and maintenance  
28 activities associated with Alternative 7 would not be adverse to the covered species, and the effects  
29 would be less than significant.

### 30 **Water Operations of CM1**

31 The methods and analysis of Alternative 7 are the same as those previously described for  
32 Alternative 1A. However, Alternative 7 includes three intakes rather than the five utilized in  
33 Alternative 1A, and Alternative 7 uses water operations scenario E. Since the size of the conveyance  
34 infrastructure and the water operations scenario differs, the effects are different.

### 35 ***Changes in Exports and Outflow***

36 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
37 Alternative 7 are anticipated to increase by 1,389 TAF relative to Existing Conditions, and by 686  
38 TAF relative to the No Action Alternative. It is important to note that some outflow changes under  
39 Alternative 7 are greater relative to Existing Conditions because Existing Conditions does not  
40 include operations to meet Fall X2, whereas NAA and Alternative 7 do include Fall X2.

41 Over the long-term, approximately 62% of the exported water will be from the new north Delta  
42 intakes, and average monthly diversions at the south Delta intakes would correspondingly decrease.

1 This is in part because of restrictions on diversions from south Delta (no diversions at the south  
2 Delta intakes in April, May, October, and November). These changes would increase the proportion  
3 of San Joaquin River water flowing throughout the South, West, and Interior Delta, and a  
4 corresponding decrease in the proportion of Sacramento River water.

5 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
6 diverted in April and May and less water diverted September through January), there would be  
7 beneficial, not adverse/less than significant, and adverse/significant and unavoidable  
8 effects/impacts on fish under Alternative 7. Following is a summary of these effects as they relate to  
9 the key factors of entrainment and flow, which in turn affects fish survival and spawning, rearing,  
10 and migration habitat conditions.

### 11 ***Entrainment***

12 Similar to Alternative 1A, overall entrainment of numerous species under Alternative 7 would be  
13 less than or similar to the levels experienced in the recent years. This is because the north Delta  
14 diversion operations would reduce reliance on south Delta export facilities (greater entrainment  
15 rates are expected to occur at south Delta facilities), along with additional minor benefits from  
16 decommissioning of agricultural diversions in restoration areas and implementation of an  
17 alternative intake for the North Bay Aqueduct. Additionally, the reduced exports under Alternative 7  
18 as compared to 1A provide further reductions in entrainment, resulting in beneficial effects for delta  
19 smelt, longfin smelt, salmonids, and sturgeon.

20 Reduced entrainment of juvenile salmonids would occur in the majority of years under all water  
21 year types relative to current conditions, whereas Alternative 1A reductions were only under the  
22 wetter conditions.

23 Finally, Alternative 7 is expected to slightly reduce Pacific and river lamprey entrainment due to  
24 reductions in south Delta exports and decommissioning agricultural diversions to an extent similar  
25 to Alternative 1A.

26 Since the proposed north Delta intakes under Alternative 7 are the same design as those proposed  
27 under Alternative 1A, the potential to affect some fish species through contact with the screens  
28 and/or increased predation around those facilities still exists but to a lesser extent because of the  
29 fewer number of intakes (three as compared to five). Regardless, these effects are considered to be  
30 not adverse.

31 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
32 in the Delta. There are very few instances where there would be increases, but these are  
33 substantially offset by decreases during other periods. Effects are at a minimum not adverse and less  
34 than significant, with effects being beneficial for many species.

### 35 ***Flows***

36 While San Joaquin River flows are not expected to be affected by Alternative 7, flow changes are  
37 expected in the Sacramento River and its tributaries, as well as within the Sacramento-San Joaquin  
38 Delta. Changes in flow will result from changes in releases from upstream reservoirs, diversions  
39 from the south Delta, and reductions in flows downstream of the proposed north Delta intakes.

40 The area of fall abiotic habitat for juvenile delta smelt in the open-water areas of the Suisun Bay,  
41 Suisun Marsh, and West Delta subregions would be larger under Alternative 7 than under NAA

1 conditions. Alternative 7 would further benefit delta smelt by habitat restoration, which has the  
2 potential to increase spawning and rearing habitat and supplement food production and export to  
3 rearing areas. Alternative 7 is not expected to substantially change migration conditions for delta  
4 smelt.

5 Based on Kimmerer et al. (2009), reduced outflows in January through June have the potential to  
6 reduce longfin smelt abundance. Average relative longfin smelt abundance would be 20 to 25%  
7 greater under Alternative 7 compared to NAA. Rearing conditions for larval and juvenile longfin  
8 smelt can also be analyzed by assessing Delta outflows. On average, Delta outflow would be similar  
9 under Alternative 7 compared to NAA from January through May, and increased by 12% in June.

10 With regard to salmonids, the effects would range from adverse to beneficial, although most would  
11 be less than significant or not adverse (Table 11-7-SUM1). For example, entrainment effects would  
12 be beneficial for spring- and fall-/late fall-run Chinook salmon, while flow reductions on almost all  
13 waterways analyzed (Sacramento, Feather, American, and Stanislaus rivers) would adversely affect  
14 meaningful portions of the fall-run population for rearing. While the flow reductions would also  
15 adversely affect spawning conditions, these effects would be primarily due to climate change, sea  
16 level rise, and future water demand, as opposed to the direct effects of the alternative. In addition,  
17 the effects of some impact mechanisms cannot be determined with existing information, and will  
18 require additional modeling. These mechanisms include effects on migration conditions for the four  
19 Chinook salmon species and steelhead, as well as spawning conditions for winter-run and spring run  
20 Chinook salmon. Additional modeling results will be reviewed to confirm potential adverse or  
21 significant effects.

22 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
23 the Yolo Bypass would provide some benefits to Sacramento splittail, primarily with regard to improved  
24 spawning and migration conditions. However, the overall effects would be not adverse.

25 Alternative 7 would result in similar effects for green and white sturgeon as those described for  
26 Alternative 1A. Alternative 7 would reduce flows and increase water temperatures, resulting in  
27 increased egg mortality and decreased rearing conditions for both species. However, these impacts  
28 would be less than significant or not adverse. Alternative 7 would result in adverse effects on  
29 migration conditions for green sturgeon, due to reduced flows in the Sacramento and Feather Rivers  
30 during adult, larval, and juvenile migration periods. Although the effects on green sturgeon  
31 migration habitat are considered unavoidable, proposed adaptive management mitigation measures  
32 have the potential to reduce the severity of the impacts though not necessarily to a less than  
33 significant level. Effects on white sturgeon migration conditions would be less than significant,  
34 relative to Existing Conditions, but targeted investigations and monitoring activities would be  
35 conducted to identify the final determination of the overall effects of Alternative 7 relative to NAA.

36 Alternative 7 would not have substantial effects on spawning and egg incubation habitat for lamprey  
37 species. Flows and temperatures under Alternative 7 would generally be similar to, or better than,  
38 those under NAA during lamprey spawning and incubation periods. Flow reductions on several  
39 waterways, including the Sacramento, Trinity, and American rivers, when compared to Existing  
40 Conditions, would have negative effects on lamprey rearing conditions. However, these effects are  
41 attributable to climate change, sea level rise, and future water demand, as opposed to direct effects  
42 of the alternative.

1 As evidenced by this summary, some changes in flow under Alternative 7 are adverse to fish species.  
 2 Alternative 7 also includes the same conservation measures as Alternative 1A, with additional  
 3 amounts of habitat restoration which provide substantial habitat improvements for fish. When the  
 4 flow and habitat restoration measures are considered together, many of the effects of Alternative 7  
 5 measures are beneficial or not adverse and/or less than significant. However, several effects  
 6 resulting from changes in flows upstream of the Delta remain adverse and/or significant and  
 7 unavoidable. Summary Table 11-7-SUM1 presents the results of the flow related effects on fish.

8 **Table 11-7-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	B/B	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	B/B		ND/LTS (combined)	
Winter-Run Chinook salmon	NA/LTS	ND/LTS	NA/LTS	ND/LTS
Spring-Run Chinook salmon	NA/B	ND/LTS	NA/LTS	ND/LTS
Fall-Run/Late Fall-Run Chinook salmon	NA/B	NA/LTS	A/SU	ND/LTS
Steelhead	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Sacramento splittail	NA/LTS	NA/LTS	NA/LTS	NA/LTS
Green sturgeon	NA/LTS	NA/LTS	NA/LTS	A/SU
White sturgeon	NA/LTS	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS
River lamprey	NA/LTS	NA/LTS	NA/LTS	NA/LTS

Level of significance:  
NEPA Conclusion                      CEQA Conclusion  
 A = Adverse.                              SU = Significant and Unavoidable.  
 NA = Not Adverse.                      LTS = Less than Significant.  
 B = Beneficial.                            B = Beneficial.  
 ND = Not Determined.                  S = Significant.

9

10 **Restoration Measures (CM2, CM4–CM7, and CM10)**

11 With respect to restoration measures, Alternative 7 is the same as Alternative 1A except that it  
 12 includes twice the restored habitat for CM5 *Seasonally Inundated Floodplain* and CM6 *Channel*  
 13 *Margin Enhancement*. That is, CM5 *Seasonally Inundated Floodplain* has 20,000 acres under  
 14 Alternative 7 rather than 10,000 acres under Alternative 1A and CM6 *Channel Margin Enhancement*  
 15 has 40 miles of channel enhancement under Alternative 7 rather than 20 miles of channel  
 16 enhancement under Alternative 1A. Consequently, all of the effects associated with Alternative 7 are  
 17 the same as Alternative 1A except for those associated with additional habitat creation or the  
 18 additional habitat itself, as described below. For a summary discussion of the effects of other  
 19 restoration measures see the complete analysis under Alternative 1A.

20 ***Effects of Construction of Restoration Measures***

21 The types of effects related to construction of restoration measures for Alternative 7 would be the  
 22 same as those described for Alternative 1A. The area of potential effects of restoration construction  
 23 activities under Alternative 7 would be greater than that described for Alternative 1A due to the  
 24 increased floodplain and channel margin habitat enhancement. However, the discussion under

1 Alternative 1A still applies because the same in-water construction window, lack of impact pile  
 2 driving, and implementation of Appendix 3B, *Environmental Commitments* would still occur. These  
 3 measures would avoid or minimize any adverse or significant effects. As a result, the effects of  
 4 construction of restoration measures are not adverse and are less than significant for covered and  
 5 non-covered fish species.

#### 6 ***Contaminants Associated with Restoration Measures***

7 The types of effects related to contaminants from construction of restoration measures for  
 8 Alternative 7 would be the same as those summarized for Alternative 1A, although the area of  
 9 potential effects would be greater due to the increased floodplain and channel margin habitat  
 10 enhancement. However, the discussion under Alternative 1A still applies and the effects would be  
 11 the same. Contaminants associated with restoration measures would not be adverse and are less  
 12 than significant for covered and non-covered fish species.

#### 13 ***Restored Habitat Conditions***

14 The effects of restored habitat conditions for CM2 *Yolo Bypass Fisheries Enhancement*, CM4 *Tidal*  
 15 *Natural Community Restoration*, and CM7 *Riparian Natural Community Restoration* would be the  
 16 same as summarized under Alternative 1A. The types of effects of restored habitat for CM5  
 17 *Seasonally Inundated Floodplain Restoration* and CM6 *Channel Margin Enhancement* would also be  
 18 the same as summarized for Alternative 1A except that double the amount of habitat would be  
 19 created. For CM5 *Seasonally Inundated Floodplain*, this doubling of habitat would provide  
 20 proportionally more benefit than that described under Alternative 1A. Consequently, increased  
 21 habitat would be most beneficial for Chinook salmon, steelhead, Sacramento splittail, green  
 22 sturgeon, and white sturgeon which would use the new habitat. All covered and non-covered species  
 23 would benefit from the increased food production either within, or exported from, the new habitat.  
 24 As described in the summary for Alternative 1A, for CM7 *Riparian Natural Community Restoration*  
 25 the restored habitat would be most beneficial for Chinook salmon, Sacramento splittail, green  
 26 sturgeon, and white sturgeon. Steelhead, Pacific lamprey, and river lamprey would receive minor  
 27 benefit. All covered and non-covered fish species would receive benefits from increased food  
 28 production associated with CM5 and CM6. The overall effects would be beneficial for all covered and  
 29 non-covered fish species.

#### 30 ***Other Conservation Measures (CM12–CM19 and CM21)***

31 With respect to other conservation measures, Alternative 7 is the same as Alternative 1A as  
 32 described above under Other Conservation Measures (CM12–CM19 and CM21). Consequently, all of  
 33 the effects associated with Alternative 7 are the same as Alternative 1A except for those associated  
 34 with additional habitat creation or the additional habitat itself. Therefore, the only other  
 35 conservation measure specifically addressed for Alternative 7 is CM12 *Methylmercury Management*.  
 36 The effects associated with the additional habitat creation and the additional habitat are  
 37 summarized below. For a summary discussion of the effects of other conservation measures see the  
 38 complete analysis under Alternative 1A.

#### 39 ***Methylmercury Management (CM12)***

40 The effects of CM12 *Methylmercury Management* would be the same as described under Alternative  
 41 1A except that they would be applied over a larger area. Consequently, these effects would not be  
 42 adverse and are less than significant.

## 1 **Comparison of Alternative 7 to Alternative 4 (Proposed Project)**

2 The substantial increase in restoration activities (20 additional miles of channel margin habitat and  
3 10,000 additional acres of seasonally inundated floodplain) are the primary differences between  
4 Alternative 7 and Alternative 4. The other difference is the operating scenario, Scenario E for  
5 Alternative 7, and Scenario H for Alternative 4. Otherwise, the number and location of the intakes  
6 would be the same, as would be the conveyance facilities and the diversion volume (up to 9,000 cfs  
7 of water). Alternative 4 also incorporates a decision tree process into Scenario H, that results in four  
8 potential operational sub-scenarios, depending on the outcome of the decision tree process for  
9 spring outflow and Fall X2 operations.

### 10 **Construction and Maintenance of CM1**

11 Due to the overall similarities in the facilities constructed, the potential for construction and  
12 maintenance activities to affect the covered fish species would be the same for Alternative 7 as for  
13 Alternative 4 (see Table 11-1A-SUM1).

### 14 **Water Operations of CM1**

15 Water operations under Alternative 7 differ from Alternative 4, although both include the same  
16 three intakes in the north Delta to convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*,  
17 average annual exports under Alternative 7 are anticipated to be 3,754 TAF, which is substantially  
18 less than anticipated exports under all four operational scenarios for Alternative 4 (4,414 to 5,255  
19 TAF). Average annual exports under Alternative 7 would also be substantially less than Existing  
20 Conditions (5,144 TAF), as well as NAA (4,441 TAF).

21 Changes in anticipated long-term average annual Delta outflow under Alternative 4 also vary  
22 between the operational scenarios (H1–H4). The average annual outflows would be between 688  
23 and 1,547 TAF greater for Alternative 7 than all the Alternative 4 operational scenarios. Alternative  
24 7 would result in greater annual average outflow (about 1,432 TAF) than Existing Conditions, and  
25 about 683 TAF more than NAA.

26 There are various benefits to entrainment and spawning conditions for some species under both  
27 alternatives, with Alternative 7 providing beneficial entrainment effects for four covered fish  
28 species, including the same two species (longfin smelt and spring-run Chinook salmon) benefiting  
29 from Alternative 4 (Table 11-7-SUM1). Both alternatives also provide beneficial effects on delta  
30 smelt rearing and Sacramento splittail migration.

31 In contrast, Alternative 7 would result in adverse or significant and unavoidable effects on  
32 migration conditions for green sturgeon, and rearing conditions for fall-, and late fall-run Chinook  
33 salmon. However, potential effects on spawning, egg incubation, and migration conditions for  
34 winter-run and spring-run Chinook salmon, as well as migration conditions for fall-/late fall-run  
35 Chinook salmon, steelhead and white sturgeon, have not yet been determined, due to existing  
36 uncertainties.

### 37 **Restoration Measures (CM2, CM4–CM7, and CM10)**

38 With respect to restoration measures, Alternative 7 would be the same as Alternative 4.  
39 Consequently, the effects of these measures would also be the same.

## 1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 With respect to other conservation measures, Alternative 7 would be the same as Alternative 4.  
3 Consequently, the effects associated with these other conservation measures would also be the same  
4 for both alternatives.

### 5 **11.0.2.14 Alternative 8—Summary of Effects**

#### 6 **Overview**

7 Alternative 8 is similar to Alternative 1A except that it involves Intakes 2, 3, and 5 instead of Intakes  
8 1, 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would divert up  
9 to 15,000 cfs and uses Operational Scenario A, Alternative 6 would divert up to 9,000 cfs from the  
10 north Delta and would use Operational Scenario F. Operational Scenario F would provide up to 1.5  
11 MAF in increased Delta outflow and would include cold water pool management criteria for specific  
12 upstream reservoirs. Additionally, Operational Scenario F includes the same rules as Operational  
13 Scenario E (including eliminating south Delta exports in April and May). Alternative 8 has the same  
14 six barge facilities as Alternative 1A.

15 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
16 these CMs would be identical to those under Alternative 1A.

#### 17 **Construction and Maintenance of CM1**

18 As indicated above for Alternative 1A, the potential for construction and maintenance activities to  
19 affect the covered fish species would typically be proportional to the number of north Delta intakes  
20 constructed, and the total area of habitat affected. Alternative 8 includes the same three intakes as  
21 Alternative 7. Therefore, the total area affected by intake construction would be the same as those  
22 described above for Alternative 7. Alternative 8 would also have similar, although less, effects from  
23 intake construction and maintenance activities compared to Alternative 1A (see Table 11-1A-SUM1).  
24 As with Alternative 1A however, Alternative 8 includes a conveyance tunnel and six barge landings,  
25 so the effects of constructing these facilities would be about the same as those discussed above for  
26 Alternative 1A.

27 At each Alternative 8 intake, between 1.3 and 6.9 acres of river area would be isolated behind  
28 cofferdams, and temporarily or permanently lost, for a maximum total estimate of 18.1 acres.  
29 Although these areas vary by intake, the overall effects would be about 37% less than for Alternative  
30 1A (28.7 acres). During the in-water construction period, a total of up to about 17 acres of in-water  
31 habitat would be affected by dredging activities, this loss or alteration of low-quality spawning,  
32 rearing, and migration habitat for covered fish species would also be about 37% less than for  
33 Alternative 1A (see Table 11-1A-SUM1). Likewise, the footprint of the intake and transition wall  
34 structures would result in permanent loss of about 7,450 feet of primarily steep-banked and  
35 riprapped shoreline habitat, or about 37% less than for Alternative 1A. The barge landings would  
36 include in-water and over-water structures, occupying approximately 15,000 square feet of  
37 shoreline habitat each, and the total would be similar to Alternative 1A.

38 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
39 potential to cause adverse effects on covered species, although these adverse effects would be  
40 effectively avoided and minimized by implementing environmental commitments and BMPs (see  
41 Appendix 3B, *Environmental Commitments*). These include pile driving minimization measures

1 AQUA-1a and AQUA-1b, as well as isolating much of the in-water work inside cofferdams,  
2 constructing in areas that have limited use by the covered species, adhering to the approved in-  
3 water work windows, and activity-specific timing restrictions. While individual fish may be affected  
4 by construction activities, the effects would not limit overall population productivity.

5 In summary, construction and maintenance activities would result in limited temporary and  
6 permanent effects on the covered fish species or their habitat. While these effects would vary by  
7 species and species life stages, the implementation of environmental commitments and BMPs (see  
8 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
9 not adverse and less than significant. The implementation of habitat restoration activities,  
10 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
11 the intake sites.

## 12 **Water Operations of CM1**

13 The methods and analysis of Alternative 8 are the same as those previously described for  
14 Alternative 1A. However, Alternative 8 includes three intakes rather than the five utilized in  
15 Alternative 1A, and Alternative 8 uses water Operational Scenario F (which includes the same rules  
16 as Alternative 7; Operational Scenario E). Since the size of the conveyance infrastructure and the  
17 water operations scenario differs, the effects are different.

## 18 ***Changes in Exports and Outflow***

19 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
20 Alternative 8 are anticipated to decrease by 2,046 TAF relative to Existing Conditions, and by 1,342  
21 TAF relative to the No Action Alternative. Over the long-term, approximately 70% of the exported  
22 water will be from the new north Delta intakes, and average monthly diversions at the south Delta  
23 intakes would correspondingly decrease. This is in part because of restrictions on diversions from  
24 south Delta (no diversions at the south Delta intakes in April and May). These changes would  
25 increase the proportion of San Joaquin River water flowing throughout the south, west, and interior  
26 Delta, and a corresponding decrease in the proportion of Sacramento River water.

27 Under Alternative 8, long-term average annual Delta outflow is anticipated to increase 2,195 TAF  
28 relative to Existing Conditions and by 1,445 TAF relative to the NAA.

29 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
30 diverted from mid-February through May and less water diverted June through January), there  
31 would be beneficial, not adverse/less than significant, and adverse/significant and unavoidable  
32 effects/impacts on fish under Alternative 8. Following is a summary of these effects as they relate to  
33 the key factors of entrainment and flow, which in turn affects fish survival and spawning, rearing,  
34 and migration habitat conditions.

## 35 ***Entrainment***

36 Under Alternative 8 several more species would experience benefits with respect to entrainment  
37 than under Alternative 1A. This is because the Alternative 8 operations would have less reliance on  
38 south Delta export facilities (greater entrainment rates are expected to occur at south Delta  
39 facilities), including no diversion from the south Delta intakes in April and May, along with  
40 additional minor benefits from decommissioning of agricultural diversions in restoration areas and  
41 implementation of an alternative intake for the North Bay Aqueduct. Additionally, the reduced

1 exports under Alternative 8 as compared to 1A provide further reductions in entrainment, resulting  
2 in beneficial effects for several species.

3 Beneficial effects with respect to entrainment would be experienced by delta smelt, winter-run  
4 Chinook salmon, spring-run Chinook salmon, fall-run/late-fall run Chinook salmon, steelhead, green  
5 sturgeon, and white sturgeon, relative to Existing Conditions. Although entrainment effects on delta  
6 and longfin smelt would be beneficial, relative to NAA, for the other species the effects would not be  
7 adverse.

8 Since the proposed north Delta intakes under Alternative 8 are the same design as those proposed  
9 under Alternative 1A, the potential to affect some fish species through contact with the screens  
10 and/or increased predation around those facilities still exists but to a lesser extent because of the  
11 fewer number of intakes (three as compared to five). Regardless, these effects are considered to be  
12 not adverse.

13 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
14 in the Delta. There are very few instances where there would be increases, and these are  
15 substantially offset by decreases during other periods. Effects are at a minimum not adverse and less  
16 than significant, with effects being beneficial for many species, particularly relative to Existing  
17 Conditions.

#### 18 **Flows**

19 While San Joaquin River flows are not expected to be affected by Alternative 8, flow changes are  
20 expected in the Sacramento River and its tributaries, as well as within the Sacramento-San Joaquin  
21 Delta. Changes in flow will result from changes in releases from upstream reservoirs, reduced  
22 diversions from the south Delta, and reduced flows downstream of the proposed north Delta  
23 intakes.

24 The abiotic habitat index under Alternative 8 across all water years would be similar (<5% change)  
25 to NAA without restoration. Alternative 8 also has the potential to benefit delta smelt by habitat  
26 restoration, particularly in the Suisun Marsh, West Delta, and Cache Slough ROAs through increased  
27 spawning and rearing habitat and supplement food production and export. With habitat restoration,  
28 Alternative 8 flows may result in a 30% increase in the average abiotic habitat index compared to  
29 the NAA. These overall effects would be due to the inundation of new areas of the Delta resulting  
30 from habitat restoration effects; it is assumed that 100% of the newly restored habitat would be  
31 utilized by delta smelt. Alternative 8 is not expected to substantially change migration conditions for  
32 delta smelt.

33 Increased spring outflows under Alternative 8 would contribute to increases in longfin smelt  
34 abundance from increased larval transport flows and spring habitat quantity and quality for larval  
35 and early juvenile longfin smelt in the Suisun Marsh and west Delta subregions. Predicted average  
36 relative longfin smelt abundance would be increased by up to 57% under Alternative 8 compared to  
37 NAA conditions, with particular increases in below normal, dry, and critical water year types.  
38 Rearing conditions for larval and juvenile longfin smelt can also be analyzed by assessing Delta  
39 outflows. On average, January–March Delta outflows would be similar to NAA conditions, while  
40 outflows would be increased under Alternative 8 from April–June by 10–14%.

41 With regard to salmonids, several issues were identified as described below with many of them  
42 resulting in adverse and/or significant effects (i.e., compared to NAA and Existing Conditions,  
43 respectively). For example, Sacramento River attraction flows for migrating adult salmonids would

1 be lower from operations of the north Delta diversions under Alternative 8, but not necessarily to an  
2 adverse level. Winter-run Chinook salmon would be adversely affected by reduced spawning and  
3 egg incubation habitat (higher egg mortality), reduced extent and quality of fry and juvenile rearing  
4 habitat, and reduced migration conditions as a result of reduced flows. These same flow reductions  
5 would reduce rearing and migration habitat to an adverse level for spring-run salmonids. Similarly,  
6 the effects on migration habitat for fall-run/late-fall run Chinook salmon would be adverse.  
7 Although the adverse effects would be unavoidable, proposed adaptive management mitigation  
8 measures would reduce the severity of the impacts, although not necessarily to a less than  
9 significant or not adverse level.

10 Steelhead would be adversely affected for two parameters under Alternative 8. While there are  
11 benefits to a decrease in the occurrence of unsuitable water temperatures for rearing in the Feather  
12 River and higher flows on several waterways during some months, the flow reductions during key  
13 periods (March and April, dry years in particular) would have an adverse effect on juvenile  
14 steelhead rearing and steelhead migration conditions. While there is no feasible mitigation available,  
15 proposed monitoring and modeling mitigation has the potential to reduce the severity of impact  
16 though not necessarily to a less than significant level.

17 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
18 the Yolo Bypass provide substantial benefits to Sacramento splittail, primarily with regard to  
19 spawning and migration. Overall effects on Sacramento splittail would not be adverse.

20 Alternative 8 would result in similar effects for green and white sturgeon as those described for  
21 Alternative 1A. Alternative 8 would reduce flows and increase water temperatures, resulting in  
22 increased egg mortality and reduced rearing, although these effects would not be adverse and less  
23 than significant. However, reductions Sacramento and Feather River flows during multiple months  
24 would adversely affect the migratory abilities of all three life stages by slowing or inhibiting  
25 downstream migration of larvae and reducing the ability to sense upstream migration cues and pass  
26 impediments by adults. Proposed adaptive management mitigation measures would have the  
27 potential to reduce the severity of impact, although not necessarily to a not adverse level.

28 Similar to sturgeon, Alternative 8 would affect spawning and egg incubation habitat for lamprey  
29 species as a result of increased water temperatures on the Feather River and redd dewatering in the  
30 Sacramento and American rivers. Flow reductions on several waterways, including the Sacramento,  
31 Trinity, and American rivers would have an adverse effect on river lamprey rearing and migration  
32 habitat. Proposed adaptive management mitigation measures would have the potential to reduce  
33 the severity of impact, although not necessarily to a not adverse or less than significant level.

34 As evidenced by this summary, some changes in flow under Alternative 8 are adverse to fish species.  
35 Alternative 8 also includes the same conservation measures as Alternative 1A, with additional  
36 amounts of habitat restoration which provide substantial habitat improvements for fish. When the  
37 flow and habitat restoration measures are considered together, many of the effects of Alternative 8  
38 measures are beneficial or not adverse and/or less than significant. However, several effects  
39 resulting from changes in flows upstream of the Delta remain adverse and/or significant and  
40 unavoidable. While proposed adaptive management mitigation measures would have the potential  
41 to reduce the severity of impacts, although not necessarily to a not adverse level. Summary Table  
42 11-8-SUM1 presents the results of the flow related effects on fish.

1 **Table 11-8-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	B/B	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	B/LTS		ND/LTS (combined)	
Winter-Run Chinook salmon	NA/B	A/SU	A/SU	A/SU
Spring-Run Chinook salmon	NA/B	NA/LTS	A/SU	A/SU
Fall-Run/Late Fall-Run Chinook salmon	NA/B	NA/LTS	NA/LTS	A/SU
Steelhead	NA/B	NA/LTS	A/SU	A/SU
Sacramento splittail	NA/LTS	NA/LTS	NA/LTS	NA/LTS
Green sturgeon	NA/B	NA/LTS	NA/LTS	A/SU
White sturgeon	NA/B	NA/LTS	NA/LTS	A/SU
Pacific lamprey	NA/LTS	A/SU	A/SU	NA/LTS
River lamprey	NA/LTS	A/SU	A/SU	A/SU

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 8 is the same as Alternative 1A. Consequently, all  
5 the effects associated with restoration measures under Alternative 8 are the same as those  
6 described above under the Alternative 1A summary.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 With respect to other conservation measures, Alternative 8 is the same as Alternative 1A.  
9 Consequently, all the effects associated with other conservation measures under Alternative 8 are  
10 the same as those described above under the Alternative 1A summary.

11 **Comparison of Alternative 8 to Alternative 4 (Proposed Project)**

12 The operating scenario is the primary difference between Alternative 8 (Scenario F) and Alternative  
13 4 (Scenario H). Scenario H incorporates a decision tree process that results in four potential  
14 operational sub-scenarios, depending on the outcome of the decision tree process for spring outflow  
15 and Fall X2 operations. Other than that, the number and location of the intakes would be the same,  
16 as would be the conveyance facilities and the diversion volume (up to 9,000 cfs of water).

17 **Construction and Maintenance of CM1**

18 Due to the overall similarities in the facilities constructed, and the expected maintenance activities,  
19 the potential for construction and maintenance activities to affect the covered fish species would be  
20 the same for Alternative 8 as for Alternative 4 (see Table 11-1A-SUM1).

21 As discussed above, in-water and nearshore construction activities have the potential to cause  
22 adverse effects on covered species, although these adverse effects would be effectively avoided and

1 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
 2 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
 3 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
 4 that have limited use by the covered species, adhering to the approved in-water work windows, and  
 5 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
 6 the effects would not limit overall population productivity.

7 In summary, construction and maintenance activities would result in limited temporary and  
 8 permanent effects on the covered fish species and their habitat. While these effects would vary by  
 9 species and species life stages, the implementation of environmental commitments and BMPs (see  
 10 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
 11 not adverse and less than significant. The implementation of habitat restoration activities,  
 12 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
 13 the intake sites.

#### 14 **Water Operations of CM1**

15 Water operations under Alternative 8 differ from Alternative 4 in a few ways. They are similar in  
 16 that both Alternative 8 and Alternative 4 include three intakes in the north Delta to convey up to  
 17 9,000 cfs. However, As discussed in Chapter 5, *Water Supply*, average annual exports under  
 18 Alternative 8 are anticipated to be 3,098 TAF, while Alternative 4 has anticipated exports ranging  
 19 from 4,414 (under H4) to 5,255 (under H1). Changes in anticipated long-term average annual Delta  
 20 outflow under Alternative 4 also vary between the operational scenarios (H1–H4). The average  
 21 annual Delta outflows would be less for the Alternative 4 operational scenarios than Alternative 8  
 22 (between 1,450 and 2,309 TAF less). Alternative 8 would also result in greater annual average Delta  
 23 outflow than Existing Conditions (about 2,194 TAF) and the NAA (about 1,445 TAF).

24 There are various benefits to entrainment and rearing for some species under both alternatives, but  
 25 Alternative 8 has substantially more beneficial effects to entrainment than Alternative 4. The  
 26 substantive difference is that Alternative 8 results in adverse effects/significant and unavoidable  
 27 impacts on several species for spawning (winter-run Chinook salmon and the lamprey species),  
 28 rearing (winter-run and spring-run salmon, steelhead, and the lamprey species), and migration (all  
 29 the covered fish species except delta smelt, Sacramento splittail and Pacific lamprey), whereas  
 30 Alternative 4 doesn't result in any adverse effects/significant and unavoidable impacts.

#### 31 **Restoration Measures (CM2, CM4–CM7, and CM10)**

32 With respect to restoration measures, Alternative 8 would be the same as Alternative 4.  
 33 Consequently, the effects of these measures would also be the same.

#### 34 **Other Conservation Measures (CM12–CM19 and CM21)**

35 With respect to other conservation measures, Alternative 8 would be the same as Alternative 4.  
 36 Consequently, the effects associated with these other conservation measures would also be the same  
 37 for both alternatives.

## 1 **11.0.2.15 Alternative 9—Summary of Effects**

### 2 **Overview**

3 Alternative 9 is similar to Alternative 1A in that 15,000 cfs would be diverted to the south Delta.  
4 However, under Alternative 9 there would be four basic corridors. Two corridors would convey  
5 Sacramento River water through the Delta via existing channels rather than through canals or  
6 tunnels. Rather than five intakes as in Alternative 1A, fish-screened intakes would be constructed at  
7 the DCC and at Georgiana Slough to convey the water into these corridors. Two other channels  
8 would be used as fish movement corridors providing for fish migration from the San Joaquin River  
9 and the Mokelumne River. Alternative 9 also includes Operational Scenario G rather than  
10 Operational Scenario A, as in Alternative 1A. Scenario G would not contain any bypass rules; rather  
11 the flow into the two water diversion channels would be controlled by tidal hydraulics and the DCC  
12 gate closure rules. Alternative 9 would include 12 additional operable gates on various waterways  
13 within the interior Delta and five barge facilities. All but one of the barge sites would be in different  
14 locations from the six barge facilities under Alternative 1A.

15 CM2, CM4–CM7, CM10, CM12–CM19, and CM21 would be implemented under this alternative, and  
16 these CMs would be identical to those under Alternative 1A.

### 17 **Construction and Maintenance of CM1**

18 Unlike the other alternatives, Alternative 9 does not include the construction of new north Delta  
19 intake facilities. Instead, the DCC gates would be modified to include fish screens, and possibly a new  
20 gate, and a Georgiana Slough screened diversion would be constructed. In-water construction would  
21 also affect environmental conditions at several other locations in the Delta: where 12 additional  
22 operable gates and five barge landings would be constructed; where several waterways would be  
23 dredged to increase channel capacity in order to convey required flows; where levees would be  
24 constructed or modified; and where canals, bridges, and pump stations would be constructed.

25 Although the in-water facilities under Alternative 9 differ from those for the other alternatives, the  
26 construction and maintenance activities would remain similar. In-water cofferdams would be  
27 constructed to isolate the work areas, potentially requiring impact pile driving, and shoreline  
28 armoring and dredging activities would also occur. However, the work would be spread over a  
29 larger area, affecting a variety of different habitats than the typical steep and armored Sacramento  
30 River shoreline.

31 In addition to the different habitats potentially affected, the multiple work sites under Alternative 9  
32 would increase the overall potential for effects, particularly due to the larger in-water footprint. The  
33 in-water footprint of the operable gates (about 15.4 total acres) would be about 32% greater than  
34 the permanent footprint of the Alternative 1A intakes (11.7 acres) (see Table 11-1A-SUM1). This is  
35 expected to result in greater in-water construction activities and a greater chance for effects from  
36 pile driving, trapping fish within the cofferdam structures, and overall habitat disturbances. There  
37 would also be about 108% more dredged area under Alternative 9 (59.6 acres) than under  
38 Alternative 1A (27.3 acres), substantially increasing the potential for direct and indirect fish losses  
39 and habitat alterations. The potential effects on water quality would also be increased. However, the  
40 area affected by the five barge landing structures (15,000 square feet each) would be less than the  
41 six landings for Alternative 1A.

1 As discussed in detail for Alternative 1A, in-water and nearshore construction activities have the  
 2 potential to cause adverse effects on covered species, although these adverse effects would be  
 3 avoided or minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
 4 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
 5 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
 6 that have limited use by the covered species, adhering to the approved in-water work windows, and  
 7 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
 8 the effects would not limit overall population productivity.

9 In summary, construction and maintenance activities would result in limited temporary and  
 10 permanent effects on the covered fish species or their habitat. While these effects would vary by  
 11 species and species life stages, the implementation of environmental commitments and BMPs (see  
 12 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
 13 not adverse and less than significant. The implementation of habitat restoration activities,  
 14 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
 15 the intake sites.

## 16 **Water Operations of CM1**

17 The methods and analysis of Alternative 9 are the same as those previously described for  
 18 Alternative 1A. However, Alternative 9 does not include intakes as described for Alternative 1A;  
 19 rather it utilizes intakes that would provide water through existing Delta channels (i.e., Through  
 20 Delta/Separate Corridors). Alternative 9 uses water Operational Scenario G. Since the type of the  
 21 conveyance infrastructure and the water operations scenario differs, the effects are different.

## 22 ***Changes in Exports and Outflow***

23 As discussed in Chapter 5, *Water Supply*, over the long term, average annual Delta exports under  
 24 Alternative 9 are anticipated to decrease by 767 TAF relative to Existing Conditions, and by 63 TAF  
 25 relative to the No Action Alternative. Additionally, 100% of the exported water will be from the  
 26 south Delta.

27 Under Alternative 9, long-term average annual Delta outflow is anticipated to increase 807 TAF  
 28 relative to Existing Conditions and by 57 TAF relative to the NAA. It is important to note that some  
 29 outflow changes under Alternative 9 are greater relative to Existing Conditions because Existing  
 30 Conditions does not includes operations to meet Fall X2, whereas NAA and Alternative 9 do include  
 31 Fall X2.

32 As a result of changes in points of diversion and the quantity and timing of diversions (more water  
 33 diverted in August through mid-January as well as April and May, and less water diverted mid-  
 34 January through March), there would be beneficial, not adverse/less than significant, and  
 35 adverse/significant and unavoidable effects/impacts on fish under Alternative 9. Following is a  
 36 summary of these effects as they relate to the key factors of entrainment and flow, which in turn  
 37 affects fish survival and spawning, rearing, and migration habitat conditions.

## 38 ***Entrainment***

39 Under Alternative 9, overall entrainment of numerous species would be less than levels experienced  
 40 in recent years. This would occur because of changes in flow in the Old River and Middle River due  
 41 to screened intakes and operable barriers that would isolate the Old River fish corridor and  
 42 associated channels from the pumping effects of the south Delta facilities. The Old River is a major

1 pathway for delta smelt entrainment and it would no longer convey water to the south Delta  
2 facilities. In addition, proposed intakes at DCC and Georgiana Slough would be screened to minimize  
3 fish entrainment for the north Delta into the main conveyance channel for Alternative 9 via Middle  
4 River. Consequently, delta smelt from the north and central Delta would experience much less  
5 pumping effects and substantially reduced south Delta entrainment, and the effects would be  
6 beneficial. The other fish migration corridors would also isolate many fish, such as migrating  
7 juvenile salmonids, from the south Delta facilities thereby substantially reducing entrainment.

8 There would be additional minor benefits from decommissioning of agricultural diversions in  
9 restoration areas and implementation of an alternative intake for the North Bay Aqueduct, these  
10 effects on the covered fish species are not adverse.

11 The proposed DCC and Georgiana Slough intakes under Alternative 9 would result in some increased  
12 predation, but the effects are considered to be not adverse.

13 In summary, entrainment is expected to remain at or below the levels currently experienced by fish  
14 in the Delta. There are very few instances where there would be increases, but these are more than  
15 offset by decreases during other periods. Effects are at a minimum not adverse and less than  
16 significant, and likely beneficial for many species.

#### 17 **Flows**

18 Some improved flows are expected in the lowermost San Joaquin River under Alternative 9 because  
19 of the isolated fish corridors. Operational flow changes are expected in the Sacramento River and its  
20 tributaries, as well as within the Sacramento-San Joaquin Delta. Changes in flow will result from  
21 changes in releases from upstream reservoirs.

22 The area of fall abiotic habitat for juvenile delta smelt in the open-water areas of the Suisun Bay,  
23 Suisun Marsh, and west Delta subregions would be similar under Alternative 9 to that under NAA  
24 conditions, without considering potential benefits of habitat restoration. Substantial increases in  
25 abiotic habitat index would occur with habitat restoration, assuming 100% habitat occupancy. In  
26 contrast to Alternative 1A, this habitat area would increase even more relative to Existing  
27 Conditions without the Fall X2 flows.

28 Unlike the other alternatives, Alternative 9 has the potential to affect migration conditions for delta  
29 smelt and other covered fish species. Alternative 9 includes 16 physical barriers that would limit  
30 movement of delta smelt in the interior Delta. However, limiting some migration pathways might  
31 reduce the risk of entrainment at the south Delta facilities.

32 Flows at Rio Vista under Alternative 9 would be similar (<10% difference) to Existing Conditions  
33 during the longfin smelt spawning period. Decreased spring outflows under Alternative 9 have the  
34 potential to contribute to decreases (by up to about 37%) in longfin smelt abundance from reduced  
35 larval transport flows and spring habitat quantity and quality for larval and early juvenile longfin  
36 smelt in the Suisun Marsh and west Delta subregions. Predicted average relative longfin smelt  
37 abundance under Alternative 9 would be increased 6–8% relative to NAA. In wet water years,  
38 relative abundance would be increased 12–15% compared to NAA. Longfin smelt may also benefit  
39 from habitat restoration actions, intended to provide additional food production and export to  
40 longfin smelt rearing areas. This potential benefit is not reflected in the X2-longfin smelt abundance  
41 regression.

1 While Sacramento River attraction flows for migrating adult salmonids would be lower from  
2 operations of the north Delta diversions under Alternative 9, it would not be to an adverse level.  
3 However, winter-run, spring-run, and fall-run/late-fall run Chinook salmon would be affected by  
4 reduced spawning and egg incubation habitat (higher egg mortality), reduced extent and quality of  
5 fry and juvenile rearing habitat and reduced migration habitat as a result of reduced flows when  
6 compared to Existing Conditions. These effects would not result in a significant impact because the  
7 differences are primarily the result of climate change, sea level rise and future water demand and  
8 not attributable to the alternative.

9 Similar to Chinook salmon, steelhead would be affected for spawning, rearing, and migration habitat  
10 due to flow reductions and temperatures in upstream tributaries. As with Chinook salmon, these  
11 effects would not result in a significant impact because the differences are primarily the result of  
12 climate change, sea level rise and future water demand, and not attributable to the alternative.

13 Generally consistent with Alternative 1A, improved flow conditions over the Fremont Weir and in  
14 the Yolo Bypass provide substantial benefits to Sacramento splittail, primarily with regard to  
15 spawning and migration. Overall effects on Sacramento splittail would not be adverse.

16 With regard to sturgeon, Alternative 9 would reduce flows and increase water temperatures,  
17 resulting in increased egg mortality and reduced rearing habitat, although not to an adverse level.  
18 While the effects on migration conditions resulting from flow changes could be adverse relative to  
19 NAA, based on the observed positive correlation between year class strength and flow, the  
20 mechanism responsible for this correlation is uncertain. However, targeted investigations are  
21 expected to identify the primary mechanisms that drive sturgeon year-class strength, and the final  
22 determination of the overall effects of Alternative 9 relative to NAA. Alternative 9 would not result  
23 in significant impacts to sturgeon relative to Existing Conditions, because the differences are  
24 primarily the result of climate change, sea level rise and future water demand and not attributable  
25 to the alternative.

26 Similar to sturgeon, Alternative 9 would affect spawning and egg incubation habitat for lamprey  
27 species as a result of increased water temperatures on the Feather River and redd dewatering in the  
28 Sacramento and American rivers. Flow reductions on several waterways, including the Sacramento,  
29 Trinity, and American rivers, when compared to Existing Conditions, would have an effect on  
30 lamprey rearing and migration habitat. As described previously for other species, these effects  
31 would not result in a significant impact because the differences are primarily the result of climate  
32 change, sea level rise and future water demand and not attributable to the alternative.

33 As evidenced by this summary, some changes in flow under Alternative 9 are adverse to fish species.  
34 Alternative 9 also includes the same conservation measures as Alternative 1A. When the flow and  
35 habitat restoration measures are considered together, several of the effects of Alternative 9 are  
36 beneficial, while most are not adverse and/or less than significant. However, the effects resulting  
37 from changes in flows upstream of the Delta remain uncertain to sturgeon migration conditions.  
38 Summary Table 11-9-SUM1 presents the results of the flow related effects on fish.

1 **Table 11-9-SUM1. Results of Flow-Related Effects on Fish**

Species	Entrainment	Spawning	Rearing	Migration
Delta smelt	B/B	NA/LTS	ND/LTS	ND/LTS
Longfin smelt	B/B		ND/LTS (combined)	
Winter-Run Chinook salmon	B/B	NA/LTS	NA/LTS	NA/LTS
Spring-Run Chinook salmon	B/B	NA/LTS	NA/LTS	NA/LTS
Fall-Run/Late Fall-Run Chinook salmon	B/B	NA/LTS	NA/LTS	NA/LTS
Steelhead	B/B	NA/LTS	NA/LTS	NA/LTS
Sacramento splittail	B/B	NA/LTS	NA/LTS	NA/LTS
Green sturgeon	B/B	NA/LTS	NA/LTS	ND/LTS
White sturgeon	B/B	NA/LTS	NA/LTS	ND/LTS
Pacific lamprey	B/B	NA/LTS	NA/LTS	NA/LTS
River lamprey	B/B	NA/LTS	NA/LTS	NA/LTS

Level of significance:

<u>NEPA Conclusion</u>	<u>CEQA Conclusion</u>
A = Adverse.	SU = Significant and Unavoidable.
NA = Not Adverse.	LTS = Less than Significant.
B = Beneficial.	B = Beneficial.
ND = Not Determined.	S = Significant.

2

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 With respect to restoration measures, Alternative 9 is the same as Alternative 1A. Consequently, all  
5 the effects associated with restoration measures under Alternative 9 are the same as those  
6 described above under the Alternative 1A summary.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 With respect to other conservation measures, Alternative 9 is the same as Alternative 1A.  
9 Consequently, all the effects associated with other conservation measures under Alternative 9 are  
10 the same as those described above under the Alternative 1A summary.

11 **Comparison of Alternative 9 to Alternative 4 (Proposed Project)**

12 The comparison of Alternative 9 with Alternative 4, would be similar to the comparison with  
13 Alternative 1A, described above. However, different habitats would be affected, due to the multiple  
14 and diverse work sites under Alternative 9 (see Table 11-1A-SUM1). This is expected to result in  
15 greater in-water construction activities, and a greater chance for effects from pile driving, trapping  
16 fish within the cofferdam structures, and overall habitat disturbances. Thereby substantially  
17 increasing the potential for direct and indirect fish losses and habitat alterations. The potential  
18 effects on water quality would also be increased, compared to Alternative 4.

19 Alternative 9 would follow Operational Scenario G, while Alternative 4 would follow Operational  
20 Scenario H, resulting in different patterns of water withdrawals from the north Delta, and  
21 potentially different effects on water quality and aquatic habitat conditions in the Plan Area. As fully  
22 described in Chapter 3, *Description of Alternatives*, Alternative 4 operations incorporate a decision

1 tree process that results in four potential operational sub-scenarios, depending on the outcome of  
2 the decision tree process for spring outflow and Fall X2 operations.

### 3 **Construction and Maintenance of CM1**

4 The potential for construction and maintenance activities to affect the covered fish species would be  
5 similar for Alternative 9 as for Alternative 4 (see Table 11-1A-SUM1). However, the magnitude of  
6 effect would be greater for Alternative 9. There would be about 233% more dredged area under  
7 Alternative 9 (59.6 acres) than under Alternative 4 (17.1 acres), as well as a 94% increase (15.2  
8 acres) in temporary habitat disturbances, and a 25% increase (3.1 acres) in the footprint of  
9 permanent structures, compared to Alternative 4. The area affected by the five barge landing  
10 structures (15,000 square feet each) would also be slightly less than the six landings for Alternative  
11 4.

12 As discussed above, in-water and nearshore construction activities have the potential to cause  
13 adverse effects on covered species, although these adverse effects would be effectively avoided and  
14 minimized by implementing environmental commitments and BMPs (see Appendix 3B,  
15 *Environmental Commitments*). These include pile driving minimization measures AQUA-1a and  
16 AQUA-1b, as well as isolating much of the in-water work inside cofferdams, constructing in areas  
17 that have limited use by the covered species, adhering to the approved in-water work windows, and  
18 activity-specific timing restrictions. While individual fish may be affected by construction activities,  
19 the effects would not limit overall population productivity.

20 In summary, construction and maintenance activities would result in limited temporary and  
21 permanent effects on the covered fish species and their habitat. While these effects would vary by  
22 species and species life stages, the implementation of environmental commitments and BMPs (see  
23 Appendix 3B, *Environmental Commitments*), would reduce most of these construction effects to be  
24 not adverse and less than significant. The implementation of habitat restoration activities,  
25 particularly CM6 *Channel Margin Enhancement*, would offset effects of habitat loss or alteration at  
26 the intake sites.

### 27 **Water Operations of CM1**

28 Water operations under Alternative 9 differ from Alternative 4 in several ways. Alternative 9  
29 includes two fish screened barriers leading into existing waterway corridors. The two corridors  
30 would be modified to convey up to 15,000 cfs, while Alternative 4 utilizes three screened intakes,  
31 and can only convey up to 9,000 cfs. As discussed in Chapter 5, *Water Supply*, average annual exports  
32 under Alternative 9 are anticipated to be 4,377 TAF, while Alternative 4 has anticipated exports  
33 ranging from 4,414 (under H4) to 5,255 (under H1). Changes in anticipated long-term average  
34 annual Delta outflow under Alternative 4 also vary between the operational scenarios (H1–H4).  
35 Average annual Delta outflows would be less for the Alternative 4 operational scenarios than  
36 Alternative 9 (between 62 and 921 TAF less). Alternative 9 would also result in greater annual  
37 average Delta outflow than Existing Conditions (about 806 TAF more) and NAA (about 57 TAF  
38 more).

39 There are various benefits to entrainment and rearing for some species under both alternatives, but  
40 Alternative 9 has more beneficial effects to entrainment than Alternative 4. Uncertainties regarding  
41 the effects of both alternatives on sturgeon migration conditions, would be addressed through  
42 targeted investigations to identify the primary mechanisms that affect sturgeon year-class strength,  
43 and the final determination of the overall effects of the alternatives relative to NAA.

1       **Restoration Measures (CM2, CM4–CM7, and CM10)**

2       With respect to restoration measures, Alternative 9 would be the same as Alternative 4.  
3       Consequently, the effects of these measures would also be the same.

4       **Other Conservation Measures (CM12–CM19 and CM21)**

5       With respect to other conservation measures, Alternative 9 would be the same as Alternative 4.  
6       Consequently, the effects associated with these other conservation measures would also be the same  
7       for both alternatives.

## 11.1 Environmental Setting/Affected Environment

This section provides a general description of the area of potential environmental effects relative to fish and aquatic resources. As described in Chapter 1, *Introduction*, the area that may be affected by BDCP alternatives—the *project area*—is divided into three separate regions, as described below.

This *Environmental Setting/Affected Environment* discussion for aquatic resources is organized into the following components.

- Section 11.1.1, *Areas of Potential Environmental Effects*
- Section 11.1.2, *Natural Communities*
- Section 11.1.3, *Species Evaluated in the EIR/EIS*
- Section 11.1.4, *Ecological Processes and Functions*
- Section 11.1.5, *Stressors*

### 11.1.1 Areas of Potential Environmental Effects

This section describes the geographic areas where potential effects may be expected to occur with implementation of the BDCP alternatives (see Chapter 1, *Introduction*). Generally, the geographic areas influenced by implementation of BDCP alternatives are described and evaluated as listed below.

- Plan Area
- Upstream of the Delta
- SWP/CVP Export Service Areas
- San Pablo and San Francisco Bays

#### 11.1.1.1 Plan Area

As described in Chapter 1, *Introduction*, the Plan Area, the area covered by the BDCP, comprises the statutory Delta (as defined in Water Code Section 12220); Suisun Bay; and the Restoration Opportunity Areas (ROAs), including those in Yolo Bypass and Suisun Marsh (see Figure 1-9). Because of its unique physical, ecological, and hydrologic characteristics, Yolo Bypass is discussed separately, following *The Delta and Suisun Bay*. A full description of surface water in these areas is provided in Chapter 6, *Surface Water*.

#### The Delta and Suisun Bay

The Delta can be divided into four regions: the north Delta, central Delta, south Delta, and west Delta. The north Delta is dominated by the waters of the Sacramento River, which are of relatively low salinity, whereas the relatively higher salinity waters of the San Joaquin River dominate the south Delta (refer to Chapter 8, *Water Quality*, for a discussion of water quality in the Sacramento River, the San Joaquin River and the Delta). The central Delta includes many channels where waters from the Sacramento and San Joaquin Rivers and their tributaries converge. The west Delta also

1 includes many channels and sloughs influenced by tidal movement, tributary inflow, local irrigation  
2 operations, and SWP and CVP operations.

3 Suisun Bay is a shallow embayment between Chipps Island at the western boundary of the Delta and  
4 the Benicia-Martinez Bridge at the eastern end of Carquinez Strait. Adjacent to Suisun Bay is Suisun  
5 Marsh, the largest brackish marsh in the United States. The narrow, 12-mile-long Carquinez Strait  
6 joins Suisun Bay with San Pablo Bay. Suisun Bay is a large area of open water that is transitional  
7 between the freshwaters of the Delta and the saltwaters of San Francisco Bay; it is a shallow region  
8 of wind-stirred, brackish water, lined with tidal marshes (Moyle 2008). The largest of these  
9 marshes—nearly as large as Suisun Bay itself—is Suisun Marsh, a 30,000+ hectare (approximately  
10 74,130-acre) marsh that is largely managed as freshwater wetlands to support waterfowl hunting  
11 (Moyle 2008). Suisun Marsh maintains its freshwater character because of inflow from the  
12 Sacramento River via Montezuma Slough (Moyle 2008). Large tidal gates on the upper end of  
13 Montezuma Slough control salinity in the marsh by allowing freshwater to flow in but preventing  
14 the tides from pushing it back out again (Moyle 2008). More than 360 kilometers (km)  
15 (approximately 225 miles) of levees separate marsh islands from the tidal channels, in which water  
16 is still seasonally brackish (Moyle 2008). The channels are highly productive of fish, which are a  
17 mixture of freshwater and marine species (Moyle 2008).

18 Seasonal and annual variability in hydrologic conditions, including the magnitude of flows into the  
19 Delta from the Sacramento and San Joaquin Rivers and other tributaries, and the outflow from the  
20 Delta into San Francisco Bay, affect habitat quality, availability, and abundance for a number of fish  
21 and invertebrate species in the Delta. For a detailed description of Delta hydrodynamics and  
22 conditions affecting Delta hydrodynamics (e.g., operations and natural hydrologic conditions), see  
23 Chapter 5, *Water Supply* and Chapter 6, *Surface Water*. For a detailed discussion on water quality  
24 objectives that influence SWP and CVP operations, see Chapter 8, *Water Quality*.

## 25 **Yolo Bypass**

26 The Yolo Bypass is a leveed, 59,000-acre floodplain on the west side of the lower Sacramento River  
27 that carries floodwaters from several northern California waterways to the Delta (Yolo Bypass  
28 Working Group 2001). Yolo Bypass (and its upstream counterpart, Sutter Bypass), convey flood  
29 flows of the Sacramento River and smaller tributaries around and away from cities such as  
30 Sacramento (Sommer et al. 2008). The Yolo Bypass is partially inundated with Sacramento River  
31 flows during parts of winter and spring, in about 70% of years (Sommer et al. 2008). The primary  
32 input to the Yolo Bypass is through Fremont Weir in the north, which conveys floodwaters from the  
33 Sacramento and Feather Rivers (Sommer et al. 2003). At peak flows, up to 24,000 hectares  
34 (approximately 59,300 acres) of the Yolo Bypass are inundated (Sommer et al. 2008). Typical  
35 dimensions are from 2 to 10 km (approximately from 1.2 to 6 miles) wide, with a mean depth of 2  
36 meters (approximately 6.5 feet) or less (Sommer et al. 2008). The floodwaters flowing through the  
37 Yolo Bypass re-enter the Sacramento River via Cache Slough (Moyle 2008). The principal permanent  
38 water channel in the Yolo Bypass is the Toe Drain, which runs along the levee on the eastern side  
39 (Moyle 2008).

40 Important ecological processes within the overall Yolo Basin include streamflow and inundation,  
41 stream erosion, and natural sediment supply. Important aquatic habitats in the Yolo Basin include  
42 stream and slough channels and seasonally inundated floodplains, for fish migration and holding,  
43 spawning, and nursery habitats (CALFED Bay-Delta Program 2000a). Important aquatic habitat in  
44 the Cache Slough complex include freshwater tidal marsh and herbaceous wetlands.

1 The Yolo Bypass provides diverse habitats for a wide variety of fish, wildlife, and plant communities,  
 2 primarily native resident (nonmigratory) fish (Table 11-1), riparian communities, seasonally and  
 3 permanently flooded wetlands, wildlife, and waterfowl (CALFED Bay-Delta Program 2000a).  
 4 Sommer et al. (1997) demonstrated that the Yolo Bypass is one of the single most important habitats  
 5 for Sacramento splittail (see Section 11.1.3.1, *Covered Fish Species*, for a discussion of Sacramento  
 6 splittail). Introduced fish species frequently dominate the fauna in the Delta on a year-round basis  
 7 (Bennett and Moyle 1996). However, unlike the other Delta habitats, the floodplain in the Yolo  
 8 Bypass is seasonally dewatered during late spring through autumn, which prevents exotic species  
 9 from establishing year-round dominance except in perennial water sources (Sommer et al. 2003).

10 **Table 11-1. Native and Introduced Fish Species Observed in the Yolo Bypass from 1997 to 2010**

Native Fish Species	Introduced Fish Species	
Chinook salmon	American shad	Redear sunfish
Steelhead/rainbow trout	Threadfin shad	Green sunfish
Pacific lamprey	Common carp	Warmouth
River lamprey	Goldfish	Black crappie
Hitch	Fathead minnow	White crappie
Sacramento blackfish	Golden shiner	Bigscale logperch
Sacramento pikeminnow	Red shiner	Largemouth bass
Sacramento sucker	Channel catfish	Smallmouth bass
Sacramento splittail	White catfish	Spotted bass
Prickly sculpin	Black bullhead	Striped bass
Pacific staghorn sculpin	Brown bullhead	Shimofuri goby
Threespine stickleback	Wakasagi	Yellowfin goby
Sacramento tule perch	Inland silverside	Pumpkinseed
Delta smelt	Western mosquitofish	
White sturgeon	Bluegill	
Longfin Smelt	Brown trout	
Hardhead	Yellow bullhead	

Source: Unpublished DWR Yolo Bypass Monitoring Data.

11  
 12 The portion of the Yolo Bypass north of the Yolo Causeway on Interstate 80 is an important  
 13 migratory route during wet years for downstream migrant Chinook salmon, steelhead, and other  
 14 native and anadromous fishes originating from upstream areas. When flooded, the Yolo Bypass  
 15 provides valuable spawning habitat for native resident fish (CALFED Bay-Delta Program 2000a). For  
 16 example, during flood pulses, the Yolo Bypass floodplain provides juvenile anadromous salmonids  
 17 an alternative migration corridor to the lower Sacramento River (Sommer et al. 2003). The results of  
 18 Sommer et al. (2001) indicated that this seasonal floodplain habitat provides better rearing  
 19 conditions than the adjacent Sacramento River channel for two reasons: (1) increased area of  
 20 suitable habitat (e.g., extensive shoals and increased habitat complexity); and (2) increased food  
 21 resources. Sommer et al. (2001) found that improved rearing conditions allowed juvenile salmon to  
 22 grow substantially faster in the Yolo Bypass floodplain than in the adjacent Sacramento River,  
 23 primarily because of a higher abundance of invertebrate prey in the floodplain.

1 In addition to providing key habitat for native and nonnative fish, seasonal inundation of the Yolo  
2 Bypass may benefit organisms downstream in the brackish portion of the San Francisco Estuary  
3 through transfer of phytoplankton and detritus (Sommer et al. 2003). Modeling studies by Jassby  
4 and Cloern (2000) suggest that phytoplankton produced in the Yolo Bypass may be an important  
5 source of organic carbon to the San Francisco Estuary, at least during flood events. The Yolo Bypass  
6 also is probably a major pathway for detrital material to reach the phytoplankton-deficient San  
7 Francisco Estuary (Sommer et al. 2003). Schemel et al. (1996 as cited in Sommer et al. 2003) found  
8 that the Yolo Bypass is the major pathway for organic matter to the San Francisco Estuary during  
9 wet years.

10 The loss and degradation of historical habitat, due to land use changes, is a major ecological stressor  
11 on fish and wildlife species throughout the Delta. These changes have resulted in the conversion of  
12 large areas of tidal and intertidal habitat to agricultural, industrial, and urban uses, resulting in  
13 dramatic reductions in the habitat available for associated fish and wildlife species (The Bay  
14 Institute 1998; CALFED Bay-Delta Program 2000). Today, these areas of former tidal marshes  
15 consist primarily of channelized waterways surrounding highly productive row-cropped  
16 agricultural islands that are protected from flooding by over 1,300 miles (2,093 kilometers) of  
17 levees. Dewatering of the marshes and plowing the peat soils for farming have led to peat oxidation  
18 losses, soil compaction, and erosion of the islands, resulting in surface subsidence. The result is that  
19 the interiors of many Delta islands have substantially subsided and are now depressions well below  
20 the level of the surrounding water, protected only by a ring of levees. Channelization, levee-building,  
21 removal of vegetation to stabilize levees, and upstream flood management have also reduced the  
22 extent of this community and altered its ecological function through changes to flooding frequency,  
23 inundation duration, and quantity of alluvial material deposition.

24 Other notable general stressors to ecological functions, processes, habitats, and species in the Yolo  
25 Basin include: (1) water diversions and historical gravel mining in the tributaries; (2) insufficient  
26 available flow to maintain a continuous riparian corridor; (3) mercury contamination from natural  
27 and previously mined sources that is taken up through the aquatic food chain; and (4) poor-quality  
28 agricultural tailwater entering the Yolo Bypass canals and sloughs (CALFED Bay-Delta Program  
29 2000a).

30 The Yolo Bypass and Fremont Weir are a source of migratory delay and loss of adult Chinook  
31 salmon, steelhead, and sturgeon (National Marine Fisheries Service 2009a). The existing fish  
32 passage structure at Fremont Weir is inadequate to allow normal fish passage at most flows due to  
33 the Army Corps of Engineers' Sacramento River Flood Control Project (National Marine Fisheries  
34 Service 2009a). Therefore, adult salmonids and sturgeon migrating upstream through the Yolo  
35 Bypass are unable to reach upstream spawning habitat in the Sacramento River and its tributaries  
36 when there is no flow through Fremont Weir (Harrell and Sommer 2003). Other structures within  
37 the Yolo Bypass, such as the Toe Drain, Lisbon Weir, and irrigation dams in the northern end of the  
38 Tule Canal, also can impede migration of adult anadromous fish (National Marine Fisheries Service  
39 2009a). Additionally, stranding of juvenile salmonids and sturgeon has been reported in the Yolo  
40 Bypass in scoured areas behind the weir and in other areas (National Marine Fisheries Service  
41 2009a). However, the 2009 National Marine Fisheries Service (NMFS) Biological Opinion (2009  
42 NMFS BiOp) on the Continued Long-term Operation of the CVP and SWP (National Marine Fisheries  
43 Service 2009a) required that the U.S. Bureau of Reclamation (Reclamation) and/or the California  
44 Department of Water Resources (DWR) submit a plan to NMFS to provide for high-quality, reliable  
45 migratory passage for Sacramento River Basin adult and juvenile anadromous fish through the Yolo  
46 Bypass.

1 The 2009 NMFS BiOp (National Marine Fisheries Service 2009a) also required that Reclamation and  
 2 DWR submit to NMFS a plan to evaluate options to: (1) restore juvenile rearing areas in the lower  
 3 Sacramento River Basin that provide seasonal inundation at appropriate intervals; (2) increase  
 4 inundation of suitable acreage within the Yolo Bypass; and (3) modify operations of the Sacramento  
 5 Weir or Fremont Weir to increase juvenile rearing habitat. Reclamation and the DWR submitted the  
 6 Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan in September,  
 7 2012. The plan addresses increasing seasonal inundation and improving fish passage in the Yolo  
 8 Bypass. Several alternatives are discussed for achieving both of these goals, including performance  
 9 measures to assess the success of the plan.

10 The southern outlet of the Yolo Bypass is Liberty Island, which is an inundated island encompassing  
 11 5,209 acres (CALFED Bay-Delta Program 2005). Liberty Island has been flooded since 1998 when its  
 12 levees were breached during high flows through the Yolo Bypass (CALFED Bay-Delta Program  
 13 2005). Between 1998 and 2005, Liberty Island has transformed from a large organic tomato farm to  
 14 over 800 acres of freshwater tidal marsh and emerging marsh, 55 acres of herbaceous wetlands, and  
 15 almost 20 acres of riparian habitat (CALFED Bay-Delta Program 2005). While nonnative fish have  
 16 dominated sampling efforts at Liberty Island, native fish species observed include Chinook salmon,  
 17 Sacramento splittail, longfin smelt, delta smelt, Sacramento tule perch, Sacramento pikeminnow, and  
 18 starry flounder (CALFED Bay-Delta Program 2005).

19 The Cache Slough Complex, which includes Liberty Island, Little Holland Tract, Hastings Tract, and  
 20 Prospect Island, has become an important focus for restoration activities in the north Delta to  
 21 increase and improve the overall habitat for delta smelt (California Department of Fish and Game  
 22 2008b). This area has high restoration potential as tidal freshwater marsh and slough habitat  
 23 because: (1) island subsidence is low compared to other parts of the Delta; (2) it maintains much of  
 24 its original drainage pattern; (3) it is a major spawning and rearing region for delta smelt; (4) it has  
 25 strong tidal currents that move water from the Sacramento River in and out of its channels; (5) it  
 26 drains the lower end of the Yolo Bypass; and (6) it contains Liberty Island (which has already been  
 27 flooded and provides high-quality habitat and ecological functions) (Moyle 2008). The region can be  
 28 converted relatively easily into favorable tidal habitat for native fish (Moyle 2008). This area is  
 29 expected to provide favorable areas for spawning and rearing, being unsuitable for egg and larval  
 30 predators (Moyle 2008).

### 31 **11.1.1.2 Upstream of the Delta**

32 As discussed in Chapter 3, *Description of Alternatives*, the areas upstream of the Plan Area that could  
 33 potentially be affected by the BDCP alternatives include those areas in the SWP and CVP system that  
 34 may be affected by alterations in SWP and CVP operations, including the reservoirs, rivers, and other  
 35 components of the SWP and CVP. These components include the following instream, reservoir, and  
 36 riparian areas.

- 37 ● Claire Engle Lake, Lewiston Lake, and the Trinity River
- 38 ● Shasta Lake and the upper and lower Sacramento River
- 39 ● Whiskeytown Reservoir and Clear Creek
- 40 ● Oroville Reservoir, Thermalito Afterbay, and the lower Feather River
- 41 ● Folsom Reservoir, Lake Natoma and the lower American River
- 42 ● New Melones Reservoir and the Stanislaus River

1       •   Millerton Reservoir and the San Joaquin River

2       The timing, duration, and magnitude of water exports affect hydrodynamic conditions that may be  
3       critical to species present in the river reaches and reservoirs upstream of the Delta. Flows within the  
4       rivers and tributaries are altered by SWP and CVP facilities and operations, and are important to the  
5       movement and migration behaviors, straying potential, habitat availability and suitability, and  
6       stranding potential of numerous aquatic species. Operational changes to flow timing, duration, and  
7       magnitude directly affect anadromous species adult immigration, spawning, egg incubation, rearing,  
8       and outmigration, as well as resident non-migratory species habitat availability for all life stages.

9       Water management and conveyance, hydrology, and water quality in these upstream rivers and  
10      reservoirs are discussed in Chapter 5, *Water Supply*; Chapter 6, *Surface Water*; and Chapter 8, *Water*  
11      *Quality*, respectively. Therefore, the following sections focus primarily on aquatic resources and  
12      provide a summary of the key stressors within each geographic area, as appropriate.

13      **Claire Engle and Lewiston Lakes**

14      The Trinity River Division consists of Trinity Dam and Claire Engle Lake, Trinity Powerplant,  
15      Lewiston Dam and Lake, Lewiston Powerplant, Clear Creek Tunnel, Judge Francis Carr Powerhouse,  
16      Whiskeytown Dam and Lake, Spring Creek Tunnel and Powerplant, Spring Creek Debris Dam and  
17      Reservoir, and related pumping and distribution facilities, which are used to divert water from the  
18      Trinity River Basin into the Sacramento River Basin.

19      Claire Engle Lake is considered relatively unproductive, with low-standing crops of zooplankton  
20      (U.S. Fish and Wildlife Service et al. 2000). The fisheries in Claire Engle Lake include both coldwater  
21      and warmwater species. Claire Engle Lake supports a trophy smallmouth bass fishery and provides  
22      substantial sportfishing for largemouth bass, rainbow and brown trout, and Kokanee salmon. Other  
23      fish species in Claire Engle Lake include Pacific lamprey, speckled dace, Klamath smallscale sucker,  
24      Coast Range sculpin, green sunfish, and brown bullhead (U.S. Fish and Wildlife Service et al. 2000).  
25      Lewiston Lake primarily supports a trout fishery (rainbow, brown, and brook trout) but also  
26      supports Pacific lamprey, Kokanee salmon, speckled dace, Klamath smallscale sucker, Coast Range  
27      sculpin, and smallmouth bass (U.S. Fish and Wildlife Service et al. 2000).

28      **Trinity River**

29      Trinity River flows out of Trinity and Lewiston Reservoirs. Native anadromous fish species in the  
30      mainstem Trinity River and its tributaries are spring- and fall-run Chinook salmon, coho salmon,  
31      steelhead (Trinity River Restoration Program 2009a), and potentially coastal cutthroat trout in the  
32      lower Klamath River (U.S. Fish and Wildlife Service et al. 2000). Native non-salmonid anadromous  
33      species that inhabit the Trinity River Basin include green sturgeon, white sturgeon, Pacific lamprey,  
34      and eulachon (U.S. Fish and Wildlife Service et al. 2000; Trinity River Restoration Program 2009).

35      The Trinity River Basin also contains various resident native and nonnative fish species, including  
36      rainbow trout, and non-game fish such as speckled dace, Klamath smallscale sucker, threespine  
37      stickleback, Coast Range sculpin, and marbled sculpin (U.S. Fish and Wildlife Service et al. 2000;  
38      Trinity River Restoration Program 2009). Nonnative fish species found in the Trinity and Klamath  
39      River Basins include American shad, brown bullhead, green sunfish, brown trout, and brook trout  
40      (U.S. Fish and Wildlife Service et al. 2000; Trinity River Restoration Program 2009). Fishing for  
41      Chinook salmon, steelhead, and rainbow and brown trout is a major recreational activity on the  
42      Trinity River throughout the year (Trinity River Restoration Program 2009).

1 Special-status (listed or of designated concern under the federal Endangered Species Act [ESA] or  
 2 California Endangered Species Act [CESA]) and recreationally and/or commercially important fish  
 3 species potentially occurring in the Trinity River are identified below.

- 4 • Southern Oregon/Northern California coastal coho salmon
- 5 • Upper Klamath/Trinity River Chinook salmon
- 6 • Klamath Mountains Province steelhead
- 7 • Green sturgeon
- 8 • White sturgeon
- 9 • Pacific lamprey
- 10 • River lamprey
- 11 • Eulachon
- 12 • American shad

13 Construction and operation of the Trinity River Dam, combined with watershed erosion, large-scale  
 14 gold dredging, and other anthropogenic disturbances, have resulted in the following changes in  
 15 habitat conditions in the Trinity River (Trinity River Restoration Program 2009).

- 16 • Obstruction to river reaches upstream of Trinity River Dam (Lewiston Dam)
- 17 • Changes to the quantity and timing of flows
- 18 • Changes in channel geomorphology
- 19 • Changes in substrate composition by the addition of fine sediments and restriction of gravel  
 20 recruitment
- 21 • Changes in water temperature

## 22 **Harvest and Hatchery Management**

23 The Trinity River Salmon and Steelhead Hatchery is operated by the California Department of Fish  
 24 and Wildlife (CDFW) and funded by Reclamation to mitigate for the loss of salmonid production  
 25 upstream of Lewiston Dam resulting from the Trinity River Dam (Trinity River Restoration Program  
 26 2009). The hatchery produces 1.4 million spring-run Chinook salmon, 2.9 million fall-run Chinook  
 27 salmon, 500,000 coho salmon, and 800,000 steelhead annually (National Marine Fisheries Service  
 28 2009a).

## 29 **Shasta Lake**

30 Aquatic habitat in Shasta Lake is related to seasonal stratification. The lake is stratified from April  
 31 through November, supporting a “two-story” fishery. During stratification, the warm upper layer  
 32 (epilimnion) (approximately 68°F) supports warmwater game fish and the lower layers  
 33 (metalimnion and hypolimnion) support the coldwater fishery. Coldwater species include rainbow  
 34 trout, brown trout, landlocked white sturgeon, landlocked coho salmon (Bureau of Reclamation et  
 35 al. 2003), and Chinook salmon (Bureau of Reclamation 2013). Warmwater species include  
 36 smallmouth bass, largemouth bass, spotted bass, black crappie, bluegill, green sunfish, channel  
 37 catfish, white catfish, and brown bullhead (Bureau of Reclamation et al. 2003). Nongame species in

1 Shasta Lake include hardhead, golden shiner, threadfin shad, common carp, Sacramento sucker, and  
2 Sacramento pikeminnow (Bureau of Reclamation et al. 2003).

3 The operation of Shasta and Sacramento River diversions can cause water surface elevations to  
4 fluctuate approximately 55 feet annually (Bureau of Reclamation et al. 2003). Reservoir surface  
5 elevation fluctuations can disturb littoral (shallow, nearshore) habitats, including spawning and  
6 rearing habitat for warmwater game fish (Bureau of Reclamation et al. 2003). Operations also  
7 influence the coldwater pool that can influence coldwater fishery habitat.

## 8 **Upper Sacramento River (Keswick Dam to Red Bluff Diversion Dam)**

9 Since the construction of Shasta Dam, the Sacramento River upstream of Red Bluff Diversion Dam  
10 (RBDD) is a perennial coldwater stream. The reach supports all four races of Chinook salmon,  
11 steelhead, and green sturgeon, as well as a popular wild trout fishery (National Marine Fisheries  
12 Service 2009a). Adult hardhead and Sacramento sucker are known to seasonally pass through the  
13 ladders at RBDD (Tehama-Colusa Canal Authority 2008). Additional fish species that may occur in  
14 this reach include Sacramento splittail, white sturgeon, rainbow trout, brown trout, largemouth  
15 bass, and smallmouth bass (see Table 11-1)(Tehama-Colusa Canal Authority 2008).

16 A major tailwater trout population supports a thriving recreational fishery due to the coldwater  
17 releases provided for winter-run Chinook salmon (National Marine Fisheries Service 2009a). There  
18 is potential that heavy angling pressure could affect salmonids in the area (National Marine  
19 Fisheries Service 2009a). Boating and other water-related activities can affect water quality and  
20 harass fish species, particularly during spawning (National Marine Fisheries Service 2009a). In  
21 addition, the U.S. Army Corps of Engineers (USACE) permitting activities that authorize dredging  
22 and other construction-related activities in the Sacramento River have modified aquatic habitat,  
23 including increasing sedimentation, simplifying streambank and riparian habitat, reducing  
24 connectivity to floodplain habitat, and modifying hydrology (National Marine Fisheries Service  
25 2009a).

## 26 **Harvest and Hatchery Management**

27 A resident rainbow trout population supports a very popular wild trout fishery in the upper  
28 Sacramento River (National Marine Fisheries Service 2009a). Because steelhead and resident  
29 rainbow trout are the same species, there is concern that the steelhead genome could be affected by  
30 breeding with resident trout. Additionally, it is possible that fishing for resident trout could affect  
31 Chinook salmon and steelhead. Seasonal closures to protect listed salmonids can reduce fishing  
32 opportunities for wild trout. Rotary screw trap data at RBDD indicate that most juvenile steelhead  
33 observed there are resident forms, based on timing and size. Zimmerman et al. (2008) found that  
34 the vast majority of steelhead collected from the Sacramento River exhibited a resident rainbow  
35 trout life history strategy.

36 The Livingston Stone National Fish Hatchery on the upper Sacramento River has been producing  
37 and releasing juvenile winter-run Chinook salmon since 1998, and is managed as a conservation  
38 hatchery. This conservation program has apparently resulted in a net increase in the numbers of  
39 returning adult winter-run Chinook salmon (Brown and Nichols 2003).

40 The Coleman National Fish Hatchery was established in 1942 to mitigate the loss of natural salmon  
41 from historical spawning areas. Long-term production goals for the hatchery are as follows:  
42 12,000,000 fall-run Chinook salmon, 1,000,000 late fall-run Chinook salmon, 250,000 winter-run

1 Chinook salmon, and 600,000 steelhead annually (U.S. Fish and Wildlife Service 2008). In 1998, the  
2 winter-run propagation program was relocated from Coleman National Fish Hatchery to the  
3 Livingston Stone National Fish Hatchery on the Sacramento River. Winter-run Chinook salmon still  
4 have access to Battle Creek above the Coleman National Fish Hatchery weir from a fish ladder that is  
5 open during the peak of the winter-run Chinook salmon migration period (Ward and Kier 1999).  
6 However, if a winter-run Chinook salmon population exists in Battle Creek, its population size is  
7 unknown, likely very small, and is potentially mainly or entirely composed of strays from the  
8 mainstem Sacramento River.

### 9 **Lower Sacramento River (Red Bluff Diversion Dam to Confluence with Lower** 10 **American River)**

11 The following descriptions of the lower Sacramento River reaches and references therein are taken  
12 directly from Volume II of the *Ecosystem Restoration Program Plan* (CALFED Bay-Delta Program  
13 2000a):

14 South of Red Bluff, the river meanders over a broad alluvial floodplain confined by older, more  
15 consolidated geologic formations (i.e., more cohesive deposits resistant to bank erosion). The extent  
16 of river floodplain and active channel meander belt from Red Bluff to Chico Landing has remained  
17 relatively unchanged and includes a significant amount of riparian forest and wildlife. The Chico  
18 Landing to Colusa reach includes the mouth of Stony Creek and no other major tributaries. In this  
19 reach, most of the high flow during storm runoff events leaves the river along the east bank and  
20 enters the expansive floodplain of Butte Basin. Much of the river downstream of Chico Landing has  
21 been subject to flood control with an extensive system of setback levees, basin and bypass outflows,  
22 and streambank protective measures, such as riprap. However, considerable riparian forest remains  
23 within the levees along the active channel (CALFED Bay-Delta Program 2000a).

24 The Colusa to Verona reach includes the mouth of Butte Creek at the Butte Slough outfall gate, but no  
25 significant tributary inflow until the Colusa Basin drain enters the river near Knights Landing. In past  
26 years outflow at the Colusa Basin Drain has contributed to attraction of adult Chinook salmon from  
27 their normal migratory pathway of the Sacramento River. Fish that stray into the Colusa Basin Drain  
28 are subject to stranding and loss from the spawning population (CALFED Bay-Delta Program 2000a).

29 High flows leave the river by way of the Colusa and Tisdale weirs. Farther downstream, most flow  
30 from the Sutter Bypass/Butte Slough and Sacramento River leaves the river again, flowing down the  
31 Yolo Bypass to the Delta at Rio Vista. Most of the levees in this reach have little riparian forest or  
32 remaining shaded riverine aquatic habitat. This reach is the most important spawning area for  
33 striped bass (CALFED Bay-Delta Program 2000a).

34 In addition to the fish species utilizing the Sacramento River upstream of RBDD, fish species of  
35 recreational importance utilizing the Sacramento River downstream of RBDD include striped bass  
36 and American shad (Tehama-Colusa Canal Authority 2008). Striped bass are not recognized as  
37 spawning or rearing in the Sacramento River upstream of RBDD, and American shad were  
38 reportedly unable to migrate upstream of RBDD when the gates are down (Tehama-Colusa Canal  
39 Authority 2008); current operations include year round gate openings.

### 40 **Harvest and Hatchery Management**

41 There is no hatchery stocking program in this reach of the Sacramento River. However, hatcheries  
42 located elsewhere in the Central Valley (e.g., Feather River and Battle Creek) can potentially  
43 influence wild anadromous salmonid spawning in the Sacramento River. Additional discussion of  
44 Sacramento River hatchery influences is provided in the discussion of the reach of the Sacramento  
45 River from Keswick to Red Bluff (above). Due to current harvest regulations, harvest associated with

1 Chinook salmon, steelhead, and sturgeon sportfisheries does not appear to be a threat to listed fish.  
 2 However, Chinook salmon harvest regulations are being adaptively managed on a year-to-year basis  
 3 because there is a concern for overharvest. In addition, illegal harvest (poaching) is a generally  
 4 unquantified concern for all of these species.

### 5 **Whiskeytown Reservoir**

6 The fisheries in Whiskeytown Reservoir include both coldwater and warmwater species. Native fish  
 7 species known to occur in Whiskeytown Reservoir include Sacramento sucker, California roach,  
 8 hardhead, Sacramento pikeminnow, Pacific lamprey, rainbow trout, Chinook salmon, and riffle  
 9 sculpin (U.S. Fish and Wildlife Service et al. 2000). Nonnative fish that occur in Whiskeytown  
 10 Reservoir include green sunfish, bluegill, smallmouth bass, spotted bass, largemouth bass, black  
 11 crappie, Kokanee salmon, brown trout, brook trout, brown bullhead, and channel catfish (U.S. Fish  
 12 and Wildlife Service et al. 2000).

### 13 **Clear Creek**

14 Whiskeytown Dam is a complete barrier to fish passage and is the uppermost boundary of habitat  
 15 available to anadromous fish. Special-status (listed or of designated concern under the ESA or CESA)  
 16 and recreationally and/or commercially important fish species potentially occurring in lower Clear  
 17 Creek are identified below (California Department of Water Resources 1986).

- 18 • Central Valley spring-run Chinook salmon
- 19 • Central Valley fall-/late fall-run Chinook salmon
- 20 • Central Valley steelhead
- 21 • Pacific lamprey
- 22 • Sacramento-San Joaquin roach
- 23 • Hardhead

### 24 **Harvest and Hatchery Management**

25 There are no hatcheries located on Clear Creek, although strays for other hatcheries (i.e., Feather  
 26 River Hatchery) return to Clear Creek and have the potential to impact wild spring-run Chinook  
 27 salmon. However, to re-establish spring-run Chinook salmon in Clear Creek, approximately 200,000  
 28 juveniles from the Feather River Hatchery were planted in Clear Creek annually in 1991, 1992, and  
 29 1993 (Newton and Brown 2004).

### 30 **Lake Oroville and Thermalito Afterbay**

31 The following information on Lake Oroville and associated facilities is taken from the Environmental  
 32 Water Account Draft EIS/EIR (Bureau of Reclamation et al. 2003) and Oroville Facilities Federal  
 33 Energy Regulatory Commission Relicensing Project 2100 Draft EIR (California Department of Water  
 34 Resources 2007) and references therein.

35 Like many other California foothill reservoirs, Lake Oroville is steep sided, with large surface  
 36 fluctuations and a low surface-to-volume ratio. Lake Oroville thermally stratifies in spring,  
 37 destratifies in fall, and remains destratified throughout winter. Due to the stratification, Lake  
 38 Oroville contains a two-story fishery, supporting both coldwater and warmwater fisheries that are

1 thermally segregated for most of the year. Coldwater fish use the deeper, cooler, well-oxygenated  
2 hypolimnion, whereas warmwater fish are found in the warmer, shallower, epilimnetic, and littoral  
3 zones. After the lake destratifies in fall, the two fishery components mix in their habitat utilization.

4 Lake Oroville's coldwater fishery is composed of coho salmon, brown trout, rainbow trout, and lake  
5 trout (California Department of Water Resources 2001).

6 The Lake Oroville warmwater fishery is a regionally important self-sustaining fishery. The black  
7 bass fishery is the largest warmwater fishery in terms of angler effort and economic impact on the  
8 area. Spotted bass are the most abundant bass species in Lake Oroville, followed by largemouth,  
9 redeye, and smallmouth bass, respectively. Catfish are the next most popular warmwater fish at  
10 Lake Oroville, with both channel and white catfish present in the lake. White and black crappie are  
11 also found in Lake Oroville, although populations fluctuate widely from year to year. Bluegill and  
12 green sunfish are the two primary sunfish species in Lake Oroville; redear sunfish and warmouth  
13 are also present. Although common carp are considered by many to be a nuisance species, they are  
14 abundant in Lake Oroville. The primary forage fish in Lake Oroville are wakasagi and threadfin shad.  
15 Threadfin shad were intentionally introduced in 1967 to provide forage for gamefish, whereas the  
16 wakasagi migrated down from an upstream reservoir in the mid-1970s (California Department of  
17 Water Resources 2001).

18 The Thermalito Forebay is a cold, shallow, open reservoir with minor fluctuations in surface  
19 elevations and a high surface-to-volume ratio. It remains cold throughout the year because it is  
20 supplied with cold water from Lake Oroville, although pump-back operations from the Thermalito  
21 Afterbay warm the forebay somewhat during certain times of the year. CDFW manages the forebay  
22 as a put-and-take trout fishery, where catchable (approximately 1/2 pound) trout are stocked  
23 biweekly. Rainbow and brook trout are the primary fish planted, although surplus Chinook salmon  
24 yearlings reared in the Feather River Fish Hatchery were stocked in the forebay in February 2000.  
25 Warmwater fish species found in Lake Oroville are believed to exist in the forebay in low numbers  
26 (California Department of Water Resources 2001).

27 The diverse temperature structure of the Thermalito Afterbay has provided suitable habitat for both  
28 coldwater and warmwater fish. A popular largemouth bass fishery currently exists, large trout are  
29 sometimes caught near the inlet, and an experimental steelhead fishery occurs in the afterbay. Only  
30 limited salmonid stocking occurs at the afterbay, so these fish most likely passed through the  
31 Thermalito Pumping-Generating Plant from the forebay. Although limited fish sampling has been  
32 conducted at the afterbay, smallmouth bass, rainbow trout, brown trout, redear sunfish, bluegill,  
33 black crappie, channel catfish, and common carp have all been observed. Most of the Lake Oroville  
34 sportfish probably occur in the afterbay to some degree (California Department of Water Resources  
35 2001).

### 36 **Feather River (Oroville Reservoir to Confluence with Sacramento River)**

37 The Feather River is considered to be a major tributary to the Sacramento River, providing  
38 approximately 25% of the flow (as measured at Oroville Dam) in the Sacramento River (California  
39 Department of Water Resources 2007). The lower Feather River commences at Fish Barrier Dam,  
40 downstream of Oroville Dam. The lower Feather River consists of two distinct channels with distinct  
41 flow regimes: (1) the Low Flow Channel, which extends 8 miles from Fish Barrier Dam (RM 67) to  
42 the Thermalito Afterbay Outlet (RM 59); and (2) the High Flow Channel, which extends from the  
43 Thermalito Afterbay Outlet to the confluence with the Sacramento River.

1 Special-status (listed or of designated concern under the ESA or CESA) and recreationally and/or  
2 commercially important fish species potentially occurring in the lower Feather River are identified  
3 below.

- 4 • Central Valley spring-run Chinook salmon
- 5 • Central Valley fall-/late fall-run Chinook salmon
- 6 • Central Valley steelhead
- 7 • Hardhead
- 8 • River lamprey
- 9 • Pacific lamprey
- 10 • Sacramento splittail
- 11 • Sacramento-San Joaquin roach
- 12 • Green sturgeon
- 13 • White sturgeon
- 14 • Striped bass
- 15 • American shad

16 The most important sportfish species in the lower Feather River is fall-run Chinook salmon,  
17 although striped bass and American shad are also common targets for anglers (Bureau of  
18 Reclamation et al. 2003). Anglers target both warmwater and coldwater species by fishing from the  
19 shore, using boats, or hiring a fishing guide service (California Department of Water Resources  
20 2004a).

### 21 **Harvest and Hatchery Management**

22 The Feather River Fish Hatchery was constructed by DWR in 1967 to compensate for salmonid  
23 spawning habitat lost as a result of construction of Oroville Dam. The hatchery is one of five major  
24 Central Valley hatcheries producing and releasing fall-run and spring-run Chinook salmon, and  
25 steelhead (California Department of Water Resources 2007).

### 26 **Folsom Reservoir and Lake Natoma**

27 Strong thermal stratification occurs within Folsom Reservoir annually between April and November.  
28 In terms of aquatic habitat, the upper, warmwater layer (epilimnion) of Folsom Reservoir provides  
29 habitat for warmwater fishes, whereas the reservoir's lower layers (metalimnion and hypolimnion)  
30 form a coldwater pool that provides habitat for coldwater fish species throughout summer and fall.  
31 Hence, Folsom Reservoir supports a two-story fishery during the stratified portion of the year (April  
32 through November).

33 Native species that occur in the reservoir include hardhead and Sacramento pikeminnow. However,  
34 introduced largemouth bass, smallmouth bass, spotted bass, bluegill, crappie, and catfish constitute  
35 the primary warmwater sportfisheries of Folsom Lake. The lake's coldwater sportfish species  
36 include rainbow and brown trout, Kokanee salmon, and Chinook salmon, all of which are currently  
37 or have been stocked by CDFW (Bureau of Reclamation et al. 2003). Lake Natoma supports many of

1 the same fish species found in Folsom Lake (i.e., rainbow trout, bass, sunfish, and catfish) (Bureau of  
2 Reclamation 2003).

3 Folsom Reservoir is usually subject to substantial reductions in surface elevation from late spring  
4 and summer until inflows increase during the winter rainy season and during the spring runoff  
5 period (Bureau of Reclamation 2003). Fluctuations in water surface elevation that occur during  
6 nesting periods can result in nest abandonment and adversely affect both spawning and juvenile  
7 survival of some resident warmwater fish species (Bureau of Reclamation 2003).

8 Water surface elevations in Lake Natoma typically fluctuate up to 3 feet on a daily and weekly basis  
9 (Bureau of Reclamation 2003). Lake Natoma's daily water surface elevation fluctuations, in addition  
10 to limited primary and secondary production, are believed to reduce the size and annual production  
11 of many of its fish populations, relative to Folsom Lake (Bureau of Reclamation 2003).

## 12 **Lower American River (Nimbus Dam to Confluence with Sacramento River)**

13 Use of the American River by anadromous fish is limited to the 23 miles of river below Nimbus Dam  
14 (the lower American River) (Bureau of Reclamation et al. 2003). At least 43 species of fish have been  
15 reported to occur in the lower American River system, including numerous resident native and  
16 introduced species, and several anadromous species. Special-status (listed or of designated concern  
17 under the ESA or CESA), and recreationally and/or commercially important fish species in the lower  
18 American River are identified below.

- 19 ● Central Valley spring-run Chinook salmon
- 20 ● Central Valley fall-/late fall-run Chinook salmon
- 21 ● Central Valley steelhead
- 22 ● Hardhead
- 23 ● Pacific lamprey
- 24 ● Sacramento splittail
- 25 ● Sacramento-San Joaquin roach
- 26 ● White sturgeon
- 27 ● Striped bass
- 28 ● American shad

29 The lower American River is one of the few urban rivers in California that supports relatively large  
30 runs of anadromous salmonids, which results in the river receiving high angling pressure during  
31 many years. Additionally, anglers target striped bass and American shad seasonally (Sacramento  
32 County 2008). Resident rainbow trout are present in the upper segment of the river; and a  
33 warmwater population of largemouth bass, various sunfish, and catfish comprise the remainder of  
34 the fishery (Sacramento County 2008). Fishing in the lower American River is permitted year-round,  
35 except during fall and early winter when the river is closed to protect spawning Chinook salmon as  
36 regulated by CDFW (Sacramento County 2008).

## 1 **Harvest and Hatchery Management**

2 CDFW operates the Nimbus Salmon and Steelhead Hatchery and the American River Trout Hatchery,  
 3 located immediately downstream from Nimbus Dam. The Nimbus Salmon and Steelhead Hatchery  
 4 produces anadromous fall-run Chinook salmon and steelhead. Steelhead produced in the facility are  
 5 genetically similar to Eel River steelhead and are not part of the Central Valley distinct populations  
 6 segment (DPS) nor protected under the ESA (California Hatchery Review Project 2012). Juvenile fall-  
 7 run Chinook salmon produced by the Nimbus Hatchery are released directly into the American River  
 8 and into San Pablo Bay to improve their survival rates and contribution to the fishery, as well as to  
 9 reduce the effects of competition between hatchery and wild fish (California Department of Fish and  
 10 Game and National Marine Fisheries Service 2001).

## 11 **New Melones Lake**

12 The sportfishery in New Melones Lake is focused on rainbow and brown trout, largemouth bass,  
 13 sunfishes such as black crappie and bluegill, and three species of catfish (Bureau of Reclamation  
 14 2010) minnows, suckers, Kokanee salmon, and common carp also are present in the lake (Bureau of  
 15 Reclamation 2010). Rainbow and brown trout and large channel catfish are generally restricted to  
 16 colder, deeper water during summer, when New Melones Reservoir has two distinct thermal layers  
 17 of water, although large brown trout and channel catfish are found in shallow water near steep  
 18 banks at night when they ascend to feed (Bureau of Reclamation 2010).

## 19 **Stanislaus River**

20 Historically, spring-run Chinook salmon were believed to be the primary salmon run in the  
 21 Stanislaus River, but the fall-run Chinook salmon population became dominant following  
 22 construction of Goodwin Dam. Goodwin Dam blocked upstream migration between 1913 and 1929  
 23 and currently blocks upstream migration (Yoshiyama et al. 1996; National Marine Fisheries Service  
 24 2009a). Central Valley steelhead were thought to be extirpated from the San Joaquin River system  
 25 (National Marine Fisheries Service 2009a). However, monitoring has detected small self-sustaining  
 26 (i.e., non-hatchery origin) populations of steelhead in the Stanislaus River and other streams  
 27 previously thought to be devoid of steelhead (Stanislaus River Fish Group 2003; McEwan 2001).  
 28 Other anadromous fish species that occur in the lower Stanislaus River include striped bass,  
 29 American shad, Pacific lamprey, and river lamprey (Stanislaus River Fish Group 2003). Striped bass  
 30 and American shad were introduced into the Sacramento-San Joaquin River Basin in the late 1880s  
 31 (Stanislaus River Fish Group 2003).

32 Special-status (listed or of designated concern under the ESA or CESA) and recreationally and/or  
 33 commercially important fish species potentially occurring in the Stanislaus River are identified  
 34 below (Stanislaus River Fish Group 2003).

- 35 ● Central Valley fall-/late fall-run Chinook salmon
- 36 ● Central Valley steelhead
- 37 ● Hardhead
- 38 ● River lamprey
- 39 ● Pacific lamprey
- 40 ● Sacramento-San Joaquin roach

- 1       • Green sturgeon
- 2       • White sturgeon
- 3       • Striped bass
- 4       • American shad

5       Juvenile salmonid monitoring has been conducted at Oakdale and/or Caswell on the Stanislaus River  
6       since 1995; monitoring has been used to estimate abundance of outmigrating fall-run juvenile  
7       Chinook salmon and Central Valley steelhead, and rainbow trout to the San Joaquin River (National  
8       Marine Fisheries Service 2009a). Steelhead smolts also have been occasionally observed at Caswell  
9       State Park and Oakdale (U.S. Fish and Wildlife Service 2000a). A study by Zimmerman et al. (2008)  
10       documented the presence of steelhead in the Stanislaus River.

11       The Stanislaus River historically had 113 miles of anadromous fish habitat (National Marine  
12       Fisheries Service 2009a); currently, only the lower 58 river miles are accessible to anadromous fish,  
13       with access terminating at Goodwin Dam (KDH Environmental Services 2008).

14       The presence of Old Melones Dam within New Melones Reservoir causes the release of warm  
15       surface water from New Melones Reservoir whenever storage levels fall below approximately  
16       1 million acre-feet (Stanislaus River Fish Group. 2003). In addition, Tulloch Reservoir can be  
17       warmer than 56°F through the end of October, although coldwater releases are made from New  
18       Melones Dam (California Department of Fish and Game 1998).

#### 19       **Harvest and Hatchery Management**

20       A genetic analysis of steelhead smolts captured in rotary screw traps on the Stanislaus River  
21       indicates that they are closely related to the upper Sacramento River steelhead, but not steelhead  
22       from the Mokelumne River Hatchery or Nimbus Hatchery on the American River (McEwan 2001);  
23       they appear to be a population of naturally produced fish (Stanislaus River Fish Group. 2003). No  
24       hatchery-reared steelhead are released in the San Joaquin River Basin (Stanislaus River Fish Group.  
25       2003).

#### 26       **Millerton Lake**

27       Millerton Lake is a popular recreational fishing lake, supporting striped bass and black bass. The fish  
28       assemblages in Millerton Lake have changed from the original native community composition to an  
29       introduced warmwater lake community. Introduced fish species in the reservoir include hatchery-  
30       raised rainbow trout, brown trout, Kokanee salmon, striped bass, American shad, largemouth bass,  
31       smallmouth bass, spotted bass, green sunfish, bluegill, redear sunfish, crappie, golden shiner, white  
32       sturgeon, brown bullhead, white catfish, channel catfish, common carp, mosquitofish, and inland  
33       silverside (Ecological Analysts 1980; Moyle 2002; Shaffer 2002).

34       Millerton Lake is one of the few inland lakes with a self-sustaining American shad population and a  
35       relatively successful striped bass population (Ecological Analysts 1980; Shaffer 2002). However,  
36       unstable population trends of striped bass and centrarchids indicate that the lake is not able to  
37       support a self-sustaining striped bass population (Bureau of Reclamation and California Department  
38       of Parks and Recreation 2008). Millerton Lake does not provide suitable spawning and egg-laying  
39       habitat for many fish species, including striped bass, largemouth and smallmouth bass, trout, and  
40       centrarchids (Bureau of Reclamation and California Department of Parks and Recreation 2008). The

1 lack of a littoral zone in the reservoir precludes most egg laying in that area (Bureau of Reclamation  
2 and California Department of Parks and Recreation 2008).

### 3 **San Joaquin River**

4 Friant Dam presents an upstream migration barrier to anadromous salmonids. All spawning of  
5 anadromous fish in the San Joaquin River Basin occurs in the tributaries to the San Joaquin River. As  
6 reported by Reclamation et al. (2003), the portion of the San Joaquin River from Mossdale/Vernalis  
7 to the mouth of the Merced River is the most significant for anadromous fish that use the San  
8 Joaquin River for migration. This 43-mile reach includes the confluences of the Merced, Tuolumne,  
9 and Stanislaus Rivers. Fall-run Chinook salmon, Central Valley steelhead, striped bass, American  
10 shad, and white sturgeon are the anadromous fish species present in the San Joaquin River from the  
11 Merced River confluence to Mossdale (Bureau of Reclamation et al. 2003). Shad and striped bass  
12 migrate from the Pacific Ocean via the Delta into the San Joaquin River to spawn in the spring  
13 (Bureau of Reclamation et al. 2003). Sacramento splittail, pikeminnow, and other native species are  
14 also found in the San Joaquin River (Bureau of Reclamation et al. 2003). However, this portion of the  
15 San Joaquin River is dominated by introduced species such as largemouth bass, silversides, green  
16 sunfish, and brown bullhead. Introduced species dominate in terms of numbers and biomass  
17 (Bureau of Reclamation et al. 2003).

18 Special-status (listed or of designated concern under the ESA or CESA) and recreationally and/or  
19 commercially important fish species potentially occurring in the San Joaquin River (below the  
20 Merced River confluence) are identified below.

- 21 ● Central Valley fall-/late fall-run Chinook salmon
- 22 ● Central Valley steelhead
- 23 ● Hardhead
- 24 ● Pacific lamprey
- 25 ● Sacramento splittail
- 26 ● Sacramento-San Joaquin roach
- 27 ● Green sturgeon
- 28 ● White sturgeon
- 29 ● Striped bass
- 30 ● American shad

31 The San Joaquin River Restoration Program (SJRRP), which addresses the area of the San Joaquin  
32 River extending from Friant Dam downstream to the confluence of the Merced River, has established  
33 goals related to fisheries restoration and water management in the San Joaquin River (San Joaquin  
34 River Restoration Program 2009). The SJRRP's preliminary fish population objectives relate to fall-  
35 and spring-run Chinook salmon (San Joaquin River Restoration Program 2009). Habitat objectives  
36 for the restoration area along the San Joaquin River were also developed to address physical habitat,  
37 stream flow, water temperature, and water quality impairments (see San Joaquin River Restoration  
38 Program 2009). In addition, CDFW is in the planning stages to implement a conservation hatchery  
39 below Friant Dam to produce spring-run Chinook salmon.

### 11.1.1.3 SWP/CVP Export Service Areas

As described in Chapter 1, *Introduction*, the Export Service Areas include the areas where water supply deliveries may be affected by the BDCP alternatives. SWP and CVP facilities influence habitat conditions downstream of the Plan Area. Facilities in the Export Service Areas deliver Delta exports to SWP and CVP contractors. Details regarding these facilities and operations are provided in Chapter 5, *Water Supply*. The relationship between these facilities and the fisheries resources they support are provided below.

Water exportation and facilities operations in the Export Service Areas result in both direct and indirect effects on aquatic species. Surface water elevation potentially affects survival and reproductive success of warmwater and coldwater species that occupy reservoirs in the Export Service Areas. Operational changes to water elevations may affect fisheries during critical spawning periods, overall reservoir levels, and the availability of shallow nearshore rearing habitat. Seasonal changes in reservoir water surface elevation may affect multiple life stages by altering the availability of littoral habitat and increasing the risk to stranding and nest dewatering. Additionally, facility operations within the Export Service Areas potentially alter water quality conditions such as temperature and dissolved oxygen (DO) concentrations which are important to certain aquatic species.

Many of the reservoirs in the Export Service Areas provide aquatic habitat and are stocked with fish, including trout, striped bass, centrarchids, and catfish (Table 11-2).

**Table 11-2. SWP/CVP Export Service Area Delivery Reservoirs**

Reservoirs	Coldwater Fishery	Warmwater Fishery	Central Valley Project	State Water Project
Anderson Reservoir		X		
Diamond Valley Lake	X	X		X
San Luis Reservoir and O'Neil Forebay	X	X	X	X
Castaic Lake/Lagoon	X	X		X
Lake Perris	X	X		X
Lake Mathews <sup>a</sup>				X

Sources: California Department of Fish and Game 2010a; California Department of Fish and Wildlife 2013a; Reclamation and California Department of Parks and Recreation 2005; Castaic Lake State Recreation Area 2010.

<sup>a</sup> Lake Mathews is not open to the public for recreational purposes (Metropolitan Water District Administrative Code § 4208).

### 11.1.1.4 San Pablo and San Francisco Bays

Hydrologically, the Bay may be divided into two broad subdivisions with differing ecological characteristics: a southern reach consisting of South Bay; and a northern reach composed of Central, San Pablo, and Suisun Bays (The Bay Institute 1998; CALFED Bay-Delta Program 2000a). The southern reach receives little freshwater discharge, leading to high salinity and poor circulation (high residence time). It also has more extreme tides. The northern reach, which directly receives Delta outflow, is characterized by less extreme tides and a pronounced horizontal salinity gradient, ranging from near full marine conditions in Central Bay to near freshwater conditions in Suisun Bay.

1 Central Bay and Suisun Bay contain large islands, features not present in San Pablo Bay and South  
2 Bay (The Bay Institute 1998; CALFED Bay-Delta Program 2000a).

### 3 **Northern Reach – Central San Francisco and San Pablo Bays**

4 Ecological factors having the greatest influence on the northern reach and marsh fish and wildlife  
5 include freshwater inflow from rivers, wetlands, riparian vegetation, and aquatic habitat diversity.  
6 Habitats in the northern reach are tidal perennial aquatic habitat, tidal saline emergent wetland,  
7 seasonal wetland, perennial grassland, agricultural land, and riparian habitat. These habitats  
8 support a variety of native marine, estuarine, freshwater, and anadromous fish (CALFED Bay-Delta  
9 Program 2000a). San Francisco Bay is designated as a coastal estuary Habitat Area of Particular  
10 Concern (HAPC) and eelgrass (*Zostera marina*) is designated as seagrass HAPC for Pacific groundfish  
11 species. Fish species that currently depend on tidal marshes and adjoining sloughs, mudflats, and  
12 embayments include delta smelt, longfin smelt, Chinook salmon, green sturgeon, white sturgeon,  
13 pacific herring, starry flounder, Sacramento splittail, and striped bass (The Bay Institute 1998;  
14 CALFED Bay-Delta Program 2000a; Baxter et al. 2008). Other fish commonly found in Central Bay  
15 include northern anchovy, halibut, American shad, bay goby, white croaker, Pacific staghorn sculpin,  
16 and marine surfperches. English sole, shiner surfperch, jacksmelt, topsmelt, diamond turbot, and  
17 speckled sand dab are common in shallow waters around Central Bay. The leopard shark, sevengill  
18 shark, and the brown smoothhound are abundant in the intertidal mudflats of the Central Bay. The  
19 sand substrate and rock outcrops in the Central Bay support recreational fish such as the halibut,  
20 striped bass, rockfish, and lingcod. Stressors include water management and conveyance, water  
21 quality, legal and illegal harvest, food availability wave and wake erosion, and introduced nonnative  
22 plant and animal species (CALFED Bay-Delta Program 2000a, Baxter et al. 2008).

### 23 **Southern Reach – South San Francisco Bay**

24 The southern reach receives far less freshwater runoff and does not generally exhibit the type of  
25 estuarine circulation that occurs in the northern reach (The Bay Institute 1998). Salinity is  
26 characteristically high, often similar to nearshore ocean levels, but is generally homogeneous. The  
27 reach is characterized by a much higher residence time of water, and on average is flushed at about  
28 one-fourth the rate of the northern reach (The Bay Institute 1998).

29 The South Bay supports a primarily marine fish assemblage owing to its saline water environment.  
30 Fish species include planktivorous topsmelt, jacksmelt, bay pipefish, brown rockfish, surfperches,  
31 surf smelt, longfin smelt, diamond turbot, arrow goby, and staghorn sculpin (The Bay Institute  
32 1998). Anadromous salmonids produced in tributaries to the South Bay include steelhead and  
33 Chinook salmon.

## 34 **11.1.2 Natural Communities**

### 35 **11.1.2.1 Covered Aquatic Natural Communities**

36 The following discussion on aquatic natural communities is based on Chapter 2 of the BDCP and the  
37 Ecosystem Restoration Program Plan (ERPP) (CALFED Bay-Delta Program 2000a). The BDCP's  
38 descriptions address habitats in the Plan Area (natural communities covered by the plan) and are  
39 based on broad community descriptions that were developed for the CALFED Bay-Delta Program  
40 (CALFED) Multi-Species Conservation Strategy (MSCS) by the CALFED agencies. The description of

1 habitat types outside the Plan Area is from the ERPP, which addresses the entire area potentially  
2 affected by the BDCP alternatives.

3 This discussion includes habitats used by both aquatic and terrestrial resources. However, habitats  
4 and natural communities that could potentially be affected by BDCP activities that are used  
5 exclusively by terrestrial species (e.g., grassland and inland dune scrub) are described in Chapter 12,  
6 *Terrestrial Biological Resources*. Although there is some overlap in the discussion here and in  
7 Chapter 12, this section describes the habitats as they pertain to aquatic resources.

## 8 **Tidal Perennial Aquatic**

9 The tidal perennial aquatic natural community occurs within the Delta and Greater San Francisco  
10 Bay ecological zones. It includes deep water aquatic (greater than 10 feet deep from mean lower low  
11 tide [the lowest of the low tides in a day]), shallow aquatic (less than or equal to 10 feet deep from  
12 mean lower low tide), and unvegetated intertidal (i.e., tideflats) zones of estuarine bays, river  
13 channels, and sloughs (CALFED Bay-Delta Program 2000a). Under current operations, the tidal  
14 perennial aquatic community in the Delta is mainly freshwater, with brackish and saline conditions  
15 occurring in the western Delta during high tides and low flows.

16 Zooplankton are the primary consumers of phytoplankton in the tidal perennial aquatic community  
17 food web and are important prey for fish and macroinvertebrates. Zooplankton species composition  
18 is strongly influenced by salinity in the tidal perennial aquatic community. In the estuarine and  
19 brackish portions of the Delta, calanoid copepods, cyclopod copepods, and mysid shrimp are the  
20 primary zooplankton species. In freshwater regions, cladocerans and calanoid copepods are the  
21 dominant zooplankton present (California Department of Water Resources 2013).

22 The majority of fish species in the Delta use the tidal perennial aquatic community. This community  
23 is used by fish for foraging, spawning, egg incubation and larval development, juvenile nursery  
24 areas, and migratory corridors. Most Delta resident fish species spend their entire lives in the tidal  
25 perennial aquatic community. Other fishes in the Delta may spend certain seasons or part of their  
26 lives in different areas of the community, based on physical factors such as salinity, turbidity, DO,  
27 flow rates, and water temperature.

28 The tidal perennial aquatic community provides habitat for all of the aquatic Delta food web. Use of  
29 the tidal perennial aquatic community by individual species is often determined by multiple physical  
30 factors (e.g., flow, salinity, wind, tide, and temperature), many of which vary at multiple temporal  
31 scales (California Department of Water Resources 2013). Phytoplankton and zooplankton spend  
32 their entire lives in the water medium. Many fish spend their entire lives in the tidal perennial  
33 aquatic community and use it for foraging, spawning, rearing, resting, and migration. Resident and  
34 migratory fish use tidal perennial aquatic habitat for spawning, rearing, foraging, and escape cover.  
35 Striped bass, delta smelt, Sacramento splittail, and many resident Bay-Delta fish use this habitat for  
36 rearing and as adults (CALFED Bay-Delta Program 2000a). Young steelhead and Chinook salmon  
37 forage in these productive waters as fry and juveniles to put on weight before entering the ocean.  
38 Changes in physical attributes of the water column, such as flow, salinity and water temperature,  
39 provide environmental cues for some species to trigger the timing of biological events, such as  
40 migration and spawning. Chapter 12, *Terrestrial Biological Resources*, provides further discussion on  
41 the ecosystem functions occurring in the tidal perennial aquatic community.

42 Within the water column of the nontidal freshwater permanent emergent community, there are  
43 gradients of light, oxygen and other chemicals, pH, and temperature that combine in various ways

1 and result in a range of microhabitat types (California Department of Water Resources 2013). The  
2 tidal perennial aquatic community provides an important ecological connection between open  
3 water areas and shallow water, emergent wetlands, and riparian habitats. Much of the productivity,  
4 organic matter, and inorganic sediment from upstream waterways and marshes eventually move  
5 into this community. In the Delta, saline coastal oceanic water is mixed and diluted by flowing  
6 freshwater of rivers (California Department of Water Resources 2013). This mix of fresh and oceanic  
7 water forms a salinity gradient that varies in area and location with daily and seasonal variations in  
8 freshwater inflow and tidal action. This gradient can affect the location of species that depend on  
9 salinity, such as estuarine vegetation, and delta smelt and longfin smelt. The location of this gradient  
10 varies on multiple time scales—daily tides, monthly lunar cycle, intra-annual (seasonal) river flow  
11 patterns, interannual river flow variation from interannual rainfall variation, and long-term global  
12 climate change (see below) (Kimmerer 2004).

13 The tidal perennial aquatic community has been heavily influenced by introductions of a number of  
14 nonnative species on nearly every trophic level. These nonnative species have caused substantial  
15 adverse effects on the physical habitat and the food web, ultimately affecting the growth and  
16 survival of the species covered under the BDCP. In addition to physical habitat changes, introduced  
17 nonnative predatory fish have a direct impact on survival of native fish species. There has been a  
18 decline in habitat quality resulting in reduction of quantity and quality of prey due to the  
19 introduction of invasive species such as the overbite clam (*C. amurensis*) and cyclopoid copepod  
20 (*Limnoithona tetraspina*) (Baxter et. al. 2008). The estimated juvenile Chinook salmon mortality at  
21 the Clifton Court Forebay suggests that striped bass and other predatory fish, primarily nonnative,  
22 pose a threat to juvenile Chinook salmon moving downstream, especially where the stream channel  
23 has been altered from natural conditions (California Department of Water Resources 1995d).  
24 Predators such as striped bass, largemouth bass, and catfish also prey on delta smelt and splittail  
25 (U.S. Fish and Wildlife Service 1996). However, the extent that these predators may affect delta  
26 smelt and splittail populations is unknown. Brazilian waterweed *Egeria*, an invasive plant, provides  
27 excellent habitat for nonnative ambush predators such as bass (California Department of Water  
28 Resources 2013). Chapter 12, *Terrestrial Biological Resources*, provides further detailed discussion  
29 on nonnative species, including aquatic weeds, occurring in the tidal perennial aquatic community.

### 30 **Tidal Mudflat**

31 Tidal mudflats are typically the unvegetated sediments in the intertidal zone between the mean high  
32 tide and the mean lower low water. They are generally associated with tidal freshwater or brackish  
33 emergent wetlands at their upper edge and the tidal perennial aquatic community at their lower  
34 edge.

35 When the tidal mudflat community is flooded, it serves as shallow open water habitat for pelagic fish  
36 species (including Sacramento splittail, salmonids) and benthic fish species (including sturgeon).  
37 This habitat can provide refugia from predators and foraging opportunities for fishes. During low  
38 tides, smaller benthic species, such as gobies, flatfish, and sculpin, inhabit the tidal mudflats if  
39 depressions in mud provide pooled water.

### 40 **Tidal Brackish Emergent Wetland**

41 Tidal brackish emergent wetland is a transitional community between tidal perennial aquatic and  
42 terrestrial upland communities. Tidal brackish emergent wetland occurs in the San Francisco Bay  
43 saltwater/Delta freshwater mixing zone that extends from near Collinsville westward to the

1 Carquinez Strait. Tidal brackish emergent wetland is present on the south side of Suisun Bay and on  
2 islands in mid-channel, but most of its extent is present in Suisun Marsh (California Department of  
3 Water Resources 2013).

4 A productive habitat, the tidal brackish emergent wetland community provides high-quality fry and  
5 juvenile rearing habitat, such as for Sacramento splittail, salmonids, delta smelt, longfin smelt, and  
6 sturgeon. In addition, organic material is exported from the marsh to provide food to nearby fish  
7 species (Moyle 2002).

## 8 **Tidal Freshwater Emergent Wetland**

9 Tidal freshwater emergent wetland habitat is typically a transitional zone between tidal perennial  
10 aquatic and valley/foothill riparian habitats. The tidal freshwater emergent wetland community  
11 often occurs at the shallow, slow-moving, or stagnant edges of freshwater waterways or ponds in  
12 the intertidal zone and is subject to frequent, long-duration flooding (SAIC 2009). Chapter 12,  
13 *Terrestrial Biological Resources*, provides further description of tidal freshwater emergent wetland  
14 habitat communities.

15 A productive habitat, tidal freshwater emergent wetland provides food and cover for numerous  
16 terrestrial and aquatic species, including fishes. Many of the fish in the tidal perennial aquatic  
17 Natural Community also use Tidal Freshwater Emergent habitat when inundated (SAIC 2009).  
18 Younger stages (e.g., larvae, fry) of some species rear in shallower waters that support emergent  
19 vegetation. Further, many fish species use emergent vegetation as refuge from predation and high  
20 flows (California Department of Water Resources 2013).

21 Tidal freshwater emergent wetland communities provide habitat for a variety of fish and wildlife  
22 species; however, island reclamation throughout the Delta, channelization, and anthropogenic  
23 changes to flow patterns have altered the ecosystem function and habitat value of these wetlands in  
24 the watershed (The Bay Institute 1998). Chapter 12, *Terrestrial Biological Resources*, provides  
25 further description of ecosystem functions of tidal freshwater emergent wetland communities.

26 Tidal freshwater emergent wetland communities occur on virtually all exposures and slopes  
27 provided the surface is saturated or at least periodically flooded by tidal action. In the Plan Area,  
28 tidal freshwater emergent wetlands typically occur on the water-side of levees where the water is  
29 not too deep (The Bay Institute 1998). Where brackish conditions occur (e.g., the western edge of  
30 the Plan Area), tidal freshwater emergent wetlands merge into tidal brackish emergent and tidal  
31 saline emergent wetlands that support plants and invertebrates tolerant of brackish or saline  
32 conditions. Physical factors that affect the location of gradients between community types include  
33 elevation, salinity and water inundation patterns at multiple temporal scales (e.g., daily tidal, lunar,  
34 seasonal, interannual). Chapter 12, *Terrestrial Biological Resources*, provides further description of  
35 environmental gradients of tidal freshwater emergent wetland communities.

## 36 **Valley/Foothill Riparian**

37 Broadly defined, the valley/foothill riparian community is often a transition zone between aquatic  
38 and upland terrestrial habitat and is found in a wide range of geologic, edaphic, and other  
39 environmental conditions (e.g., variable light and nutrient availability) (California Department of  
40 Water Resources 2013). Chapter 12, *Terrestrial Biological Resources*, provides further description of  
41 valley/foothill riparian habitat communities.

1 Riparian habitats support the greatest diversity of wildlife species of any habitat in California,  
2 including many species of fish within channel edge habitats (CALFED Bay-Delta Program 2000a).  
3 Furthermore, more extensive and continuous riparian forest canopy on the banks of estuaries and  
4 rivers stabilize channels; help shape submerged aquatic habitat structure; benefit the aquatic  
5 environment by contributing shade, overhead canopy, and instream cover for fish; and reduce river  
6 water temperature (CALFED Bay-Delta Program 2000a). More extensive and continuous shoreline  
7 vegetation associated with woody debris (branches and root wads) and leaf and insect droppings in  
8 shallow aquatic habitats will increase the survival and health of juvenile salmonids, resident Delta  
9 native fishes, and introduced resident fishes (CALFED Bay-Delta Program 2000a).

10 Riparian ecosystems provide higher ecosystem services and wildlife habitat compared to other  
11 terrestrial ecosystems (California Department of Water Resources 2013). Riparian areas serve as  
12 the hydrologic connection between terrestrial uplands and aquatic ecosystems, receiving water  
13 from precipitation, overland runoff, groundwater discharge, and flow from the adjacent water body  
14 or alluvial aquifer (California Department of Water Resources 2013).

15 Although the fish species do not rely primarily on riparian habitat per se, because they are aquatic  
16 species, they are directly and indirectly supported by the habitat services and food sources provided  
17 by the highly productive riparian ecosystem (California Department of Water Resources 2013).  
18 Riparian communities provide habitat and food for species fundamental to the aquatic and  
19 terrestrial food web, from insects to top predators (California Department of Water Resources  
20 2013). Riparian vegetation on floodplains can provide additional benefits to fish when the floodplain  
21 is inundated. For further information on ecosystem function of valley/foothill riparian habitat, refer  
22 to Chapter 12, *Terrestrial Biological Resources*.

23 Due to its location in the transition zone between aquatic and terrestrial ecosystems, the valley/  
24 foothill riparian community is characterized by biotic (e.g., species composition) and abiotic (e.g.,  
25 hydrologic) gradients (California Department of Water Resources 2013). These gradients interact to  
26 form highly diverse and complex communities, both structurally and functionally. They also interact  
27 strongly with and influence the aquatic, emergent, and upland habitats along their edges.  
28 Chapter 12, *Terrestrial Biological Resources*, further describes environmental gradient related to  
29 valley/foothill riparian communities.

### 30 **Nontidal Perennial Aquatic**

31 Nontidal perennial aquatic natural communities in the Delta can range in size from small ponds in  
32 uplands to large lakes, such as North and South Stone Lakes (California Department of Water  
33 Resources 2013). The nontidal perennial aquatic natural community can be found in association  
34 with any terrestrial habitat and can transition into nontidal freshwater permanent emergent  
35 wetland and valley/foothill riparian. The littoral zone of the nontidal perennial aquatic community  
36 is defined as the portion of the water column penetrable by light and that occurs at the edges of  
37 lakes and throughout most ponds (California Department of Water Resources 2013). The limnetic  
38 zone extends below the littoral zone to the deepest part of the water body. Chapter 12, *Terrestrial*  
39 *Biological Resources*, provides further description of Nontidal Perennial Aquatic habitat.

40 A thin layer of floating duckweed often covers the surface of shallow nontidal perennial aquatic  
41 waters. Desmids, diatoms, protozoans, crustaceans, hydras, and snails live on the under-surface of  
42 the layer, whereas mosquitoes and other aquatic insect larvae may live in between the plants.

1 Zooplankton, such as rotifers, copepods, and cladocerans, live suspended in the water column and  
2 graze on phytoplankton and other organic matter (California Department of Water Resources 2013).  
3 Together with phytoplankton, these organisms compose the base of the nontidal perennial aquatic  
4 food web. A variety of aquatic insects (e.g., dipterans, coleopterans, chironomids, trichopterans,  
5 plecopterans, and ephemeropterans) and springtails use the nontidal perennial aquatic habitat for  
6 their larval stage (California Department of Water Resources 2013). Native fish that can be found in  
7 some nontidal perennial aquatic communities include the Sacramento perch, hitch, and Sacramento  
8 tule perch (California Department of Water Resources 2013). Nontidal perennial aquatic  
9 communities support many nonnative freshwater fish species, including sunfish, bass, common carp,  
10 inland silverside, fathead minnow, and western mosquitofish. These species prey on or compete  
11 with native fish both directly and indirectly for resources (California Department of Water  
12 Resources 2013).

### 13 **Nontidal Freshwater Permanent Emergent Wetland**

14 The nontidal freshwater permanent emergent wetland community is composed of permanently  
15 saturated wetlands, including meadows, dominated by emergent plant species that do not tolerate  
16 permanent saline or brackish conditions (CALFED Bay-Delta Program 2000a). Nontidal freshwater  
17 permanent emergent wetland communities in the Plan Area occur in small fragments along the  
18 edges of the nontidal perennial aquatic and valley/foothill riparian natural communities.  
19 Chapter 12, *Terrestrial Biological Resources*, provides further description of the nontidal freshwater  
20 permanent emergent wetland natural community.

21 The nontidal freshwater permanent emergent wetland community in the Plan Area supports many  
22 nonnative freshwater fish species, including centrarchids, common carp, inland silverside, fathead  
23 minnow, and western mosquitofish. These nonnative species prey on or compete with native fish  
24 and amphibian species both directly and indirectly for resources. Common invasive plants found in  
25 this habitat include Brazilian waterweed *Egeria*, Eurasian watermilfoil, and water hyacinth. These  
26 plants form thick mats that exclude native vegetation and associated wildlife (California Department  
27 of Water Resources 2013).

28 The nontidal freshwater permanent emergent wetland community generally forms the boundary  
29 around the nontidal perennial aquatic community. Its most significant ecosystem functions include  
30 providing a source of primary productivity and a habitat for native fish, amphibians, and reptiles. Its  
31 importance as a source of primary productivity can increase or decrease if the body of water is  
32 dominated by algal phytoplankton or aquatic plants, depending on whether the body of water is in a  
33 turbid- or clear-water state. The presence and abundance of primary consumers can affect the  
34 ecosystem because they provide a food source for other species, including invertebrate and fish  
35 species.

36 External gradients to terrestrial ecosystems exist at the boundary of this community because it  
37 provides the transition between open water habitat and riparian forest, grassland, or agricultural  
38 lands.

### 39 **Managed Wetland**

40 The managed wetland natural community consists of areas that are intentionally flooded and  
41 managed during specific seasonal periods to enhance habitat values for specific wildlife species  
42 (CALFED Bay-Delta Program 2000a). The managed wetland community includes some areas of the

1 CALFED ERPP “seasonal wetlands” habitat and fits into the “fresh emergent wetland” classification  
2 from the California Wildlife Habitat Relationships (California Department of Water Resources 2013).

3 Within the watershed, managed wetland is distributed largely in the northern, central, and western  
4 portions of the Delta, as well as in Suisun Marsh (California Department of Water Resources 2013).  
5 Substantial acreage of this type occurs in the Yolo Bypass, Stone Lakes Wildlife Refuge, Cosumnes  
6 River Preserve, and Suisun Marsh (California Department of Water Resources 2013).

7 Managed wetlands are managed specifically to promote use by waterfowl, specifically ducks  
8 (California Department of Water Resources 2013). During winter inundation, managed wetlands in  
9 the Yolo Bypass provide spawning and rearing habitat for Sacramento splittail and refuge habitat for  
10 other fish species (California Department of Water Resources 2013).

### 11 **Cultivated Lands**

12 Agricultural land uses and cover types in the watershed primarily include grain, field, truck, and hay  
13 crops; orchards and vineyards; and irrigated pastures. Chapter 12, *Terrestrial Biological Resources*,  
14 provides further discussion on agricultural land in the watershed.

15 When inundated, the Yolo Bypass provides habitat for at least 42 fish species, including delta smelt,  
16 Sacramento splittail, Chinook salmon, steelhead, and white sturgeon (California Department of  
17 Water Resources 2013). Evidence suggests that these species benefit from floodplain inundation  
18 because of increased food, lower water velocity, and warmer water.

### 19 **11.1.2.2 Noncovered Aquatic Natural Communities**

20 The following habitat types are found within the area potentially affected by the BDCP alternatives,  
21 including the Plan Area, but they are not covered natural communities under the BDCP.

#### 22 **Valley Riverine Aquatic**

23 Valley riverine aquatic habitat includes the water column of flowing streams and rivers in low-  
24 gradient channel reaches below an elevation of approximately 300 feet that are not tidally  
25 influenced. This includes associated shaded riverine aquatic, pool, riffle, run, and unvegetated  
26 channel substrate (including seasonally exposed channel bed) habitat features, and sloughs,  
27 backwaters, overflow channels, and flood bypasses hydrologically connected to stream and river  
28 channels. Valley riverine aquatic habitat includes portions of the ERPP riparian and riverine aquatic  
29 habitat (CALFED Bay-Delta Program 2000b).

30 Anadromous and estuarine fish species, such as Chinook salmon, steelhead, Sacramento splittail,  
31 delta smelt, sturgeon, lamprey, Sacramento pikeminnow, and Sacramento perch use the valley  
32 riverine aquatic habitat (CALFED Bay-Delta Program 2000b).

#### 33 **Montane Riverine Aquatic**

34 Montane riverine aquatic habitat includes the water column of flowing streams and rivers above an  
35 elevation of approximately 300 feet. This includes associated shaded riverine aquatic, pool, riffle,  
36 run, and unvegetated channel substrate (including seasonally exposed channel bed) habitat features,  
37 and sloughs, backwaters, and overflow channels hydrologically connected to stream and river  
38 channels. Montane riverine aquatic habitat includes portions of the ERPP riparian and riverine  
39 aquatic habitat (CALFED Bay-Delta Program 2000b).

1 Anadromous fish species such as Chinook salmon, sturgeon, lamprey, Sacramento pikeminnow, and  
2 steelhead use the montane riverine aquatic habitat (CALFED Bay-Delta Program 2000b).

### 3 **Montane Riparian**

4 Montane riparian habitat includes all successional stages of woody vegetation, such as willow, black  
5 cottonwood, white alder, birch, and dogwood, within the active floodplains of moderate-to-high-  
6 gradient reaches of streams and rivers generally above an elevation of 300 feet. Montane riparian  
7 habitat includes portions of the ERPP riparian and riverine aquatic habitat (CALFED Bay-Delta  
8 Program 2000b).

### 9 **Saline Emergent**

10 Saline emergent habitat includes the portions of San Francisco, San Pablo, and Suisun Bays and the  
11 Delta that support emergent wetland plant species that are tolerant of saline or brackish conditions  
12 within the intertidal zone or are located on lands that historically were subject to tidal exchange (i.e.,  
13 diked wetlands). Saline emergent habitat includes all or portions of the ERPP saline emergent  
14 wetland tidal and Delta sloughs, and midchannel islands and shoals habitats (CALFED Bay-Delta  
15 Program 2000b).

16 Anadromous and estuarine fish species, such as Chinook salmon, steelhead, Sacramento splittail,  
17 delta smelt, and Sacramento perch use the saline emergent habitat (CALFED Bay-Delta Program  
18 2000b).

### 19 **Low Salinity Zone**

20 Pelagic fish habitat is characterized by physical and chemical properties such as salinity, turbidity,  
21 and water temperature, and biological properties such as prey production. Thus, pelagic fish habitat  
22 suitability in the estuary is at least partially influenced by variation in freshwater flow (e.g., Delta  
23 outflow) (Jassby et al. 1995; Bennett and Moyle 1996; Kimmerer 2004).

24 Several fish species use a variety of behaviors to maintain themselves within open-water areas  
25 where water quality and food resources are favorable (Bennett et al. 2002). Delta smelt, longfin  
26 smelt, striped bass, and threadfin shad distribute themselves at different concentrations of salinity  
27 within the estuarine salinity gradient (Feyrer et al. 2007; Kimmerer 2002a), indicating that, at any  
28 point in time, salinity is a major factor affecting the geographic distributions of these species. The  
29 term “low-salinity zone” (LSZ) within the San Francisco Estuary was created and is defined as the  
30 area within the estuary where salinity is approximately 0.5 to 6 parts per thousand (ppt). X2 (i.e.,  
31 roughly the center of the LSZ), is defined as salinity of around 2 ppt (Kimmerer 2002b). The term  
32 “X2” is used to define the distance from the Golden Gate Bridge upstream to where salinity near the  
33 bottom of the water column is approximately 2 ppt. Salinity between 2 and approximately 30 ppt is  
34 roughly linearly distributed between X2 and the mouth of the estuary (Monismith et al. 1996). X2  
35 reflects the physical response of the San Francisco Estuary to changes in flow and provides a  
36 geographic frame of reference for estuarine conditions (Kimmerer 2002b). The estuary responds to  
37 freshwater flow, as characterized by the statistical relationship between X2 and flow (Kimmerer  
38 2004). Because the position of X2 relies on a number of physical parameters, including river flows,  
39 water diversions and tides, its position shifts over many kilometers on a daily and seasonal cycle.  
40 Over the course of a year, the location of X2 can range from San Pablo Bay during high river flow  
41 periods to up into the Delta during low-flow periods (generally summer/fall).

1 Relationships between X2 and abundance of fish and aquatic species have been developed for many  
 2 estuarine-dependent copepods, mysids, bay shrimp, and several fishes—including longfin smelt,  
 3 Pacific herring, starry flounder, Sacramento splittail, American shad, and striped bass (Kimmerer  
 4 2002a). For example, Feyrer et al. (2007) reported that higher outflow that expands and moves  
 5 delta smelt habitat downstream of the Delta is expected to improve conditions for delta smelt.  
 6 Kimmerer (2002a) found that distributions of fish species including striped bass, Sacramento  
 7 splittail, longfin smelt, delta smelt, and starry flounder, substantially overlapped with the LSZ.

8 According to California Department of Fish and Game (2010a), the available data and information  
 9 indicate that (1) the abundance of many fish and aquatic species is related to water flow timing and  
 10 quantity; (2) for many fish and aquatic species, more water flow translates into greater species  
 11 production or abundance; (3) fish and aquatic species are adapted to use the water resources of the  
 12 Delta during all seasons of the year, but for many species, important life history stages or processes  
 13 consistently coincide with increased winter-spring flows; and (4) the source, quality, and timing of  
 14 water flows through the estuary influences the production of Chinook salmon in both the San  
 15 Joaquin River and Sacramento River Basins (California Department of Fish and Game 2010b).

16 The extent of the low salinity zone, which is determined by the location of the X2 isohaline, largely  
 17 overlaps with the distribution of other essential physical resources and key biotic resources that are  
 18 necessary to support delta smelt, but is not the only factor that defines the extent of habitat for delta  
 19 smelt. The delta smelt fall abiotic habitat index developed by Feyrer et al. (2011) is based on the  
 20 probability of presence of delta smelt given certain water clarity and salinity and does not account  
 21 for other abiotic (e.g., water velocity, depth) and biotic (e.g., food density) factors that may interact  
 22 with water clarity and salinity to influence the probability of occurrence. The three physical  
 23 variables (temperature, salinity, and turbidity) combined could explain just a quarter of the variance  
 24 in patterns of delta smelt presence and absence in the estuary. It is unclear what portion of that  
 25 fractional explained variance is actually due to turbidity, rather than salinity. While temperature  
 26 was not found to be a predictor of delta smelt presence in the fall, although it has been shown to be  
 27 important during summer months (Nobriga et al. 2008).

28 The overall relationship between X2 and the delta smelt fall abiotic habitat index is the result of two  
 29 linked statistical analyses, each of which include uncertainties that are compounded when the  
 30 analyses are combined. In addition, while the position of X2 is correlated with the distribution of  
 31 salinity and turbidity regimes (Feyrer et al. 2007), the relationship of that distribution and smelt  
 32 abundance indices is not clear (National Research Council 2010). Nevertheless, this method has  
 33 been previously applied to analyses for delta smelt habitat and therefore is included in this analysis  
 34 of relative comparisons between action alternatives and baseline conditions.

### 35 **11.1.3 Species Evaluated in the EIR/EIS**

#### 36 **11.1.3.1 Covered Fish Species**

37 The following endangered or threatened species are identified as covered species in the BDCP, and  
 38 DWR is requesting incidental take of these species.

- 39 • Delta smelt (State endangered/Federally threatened)
- 40 • Longfin smelt (State threatened)

- 1 • Chinook salmon, Sacramento River winter-run evolutionarily significant unit (ESU) (State  
2 endangered/Federally endangered)
- 3 • Chinook salmon, Central Valley spring-run ESU(State threatened/Federally threatened)
- 4 • Chinook salmon, Central Valley fall-and late-fall run ESU(State species of concern/Federal  
5 species of concern)
- 6 • Steelhead, Central Valley DPS(Federally threatened)
- 7 • Sacramento splittail (State species of concern)
- 8 • Green sturgeon, southern DPS (State species of concern/Federally threatened)
- 9 • White sturgeon (State species of concern)
- 10 • Pacific lamprey (State species of concern)
- 11 • River lamprey (State species of concern)

12 All of the fish species above are listed as threatened or endangered under the ESA. threatened or  
13 endangered under CESA or California species of special concern identified by DFW. They are  
14 addressed in this document if they would be affected by the project.

15 In addition to the ESA listings, the Plan Area contains critical habitat designated under the ESA, and  
16 essential fish habitat (EFH) protected under the Magnuson-Stevens Fishery Conservation and  
17 Management Act, for the following species:

- 18 • Chinook salmon, Sacramento River winter-run ESU – critical habitat and EFH
- 19 • Chinook salmon, Central Valley spring-run ESU – critical habitat and EFH
- 20 • Chinook salmon, Central Valley fall-and late-fall run ESU – EFH
- 21 • Steelhead, Central Valley DPS – critical habitat
- 22 • Delta smelt – critical habitat
- 23 • Green sturgeon, southern DPS – critical habitat

24 The fish species accounts, geographic distribution, and life history timings of the covered species in  
25 the watershed are summarized in Appendix 11A.

### 26 **11.1.3.2 Noncovered Species**

27 Noncovered fish and aquatic species are species which are not listed as endangered or threatened  
28 under state and federal endangered species acts, have ecological, recreational, or commercial  
29 importance and are assessed in this document for impacts. The noncovered fish and aquatic species  
30 are listed below:

- 31 • Striped bass
- 32 • American shad
- 33 • Largemouth bass
- 34 • Sacramento–San Joaquin roach
- 35 • Hardhead (State species of concern)

- 1       • Sacramento perch
- 2       • Sacramento tule perch
- 3       • Threadfin shad
- 4       • California bay shrimp

5       The fish and aquatic species accounts of the non-covered species in the watershed are summarized  
6       in Appendix 11B. Sacramento perch are essentially extirpated from the Sacramento-San Joaquin  
7       system (Appendix 11B) and are not addressed further.

## 8       **11.1.4       Ecological Processes and Functions**

9       Because of the interconnectedness of hydrology throughout the system known as the San Francisco  
10       Bay-Delta watershed, an overview of activities throughout the watershed is essential to an  
11       understanding of current conditions in the Plan Area. Historical modification of ecosystem processes  
12       and functions in the Plan Area and throughout the watershed have influenced the current conditions  
13       of natural communities and special-status species. Since the Gold Rush, agricultural and residential  
14       development; land reclamation; flood control measures; water management and diversions;  
15       sediment movement and deposition associated with gold mining; contamination from gold mining  
16       and pesticide use; introduction of invasive nonnative vegetation, wildlife, and aquatic species; and  
17       other human influences have affected the ecosystem processes and functions. As a result of these  
18       influences, carbon and nutrient cycling in the ecosystem and the maintenance of biodiversity have  
19       been changed, affecting both terrestrial and aquatic ecosystems.

### 20       **11.1.4.1       Hydrology**

21       A full description of hydrology is provided in Chapter 5, *Water Supply* and Chapter 6, *Surface Water*.  
22       The following is provided as a brief overview of hydrologic conditions.

23       The volume and distribution of water in the watershed influence important ecological processes and  
24       functions. Streamflows within the watershed are extremely variable. Most of the unimpeded flow  
25       occurs from December through June. A large part of the total flow volume occurs during relatively  
26       short periods, caused either by rainfall or snowmelt. Construction and operation of dams on major  
27       rivers and streams has reduced peak winter and spring flows, and increased summer and fall flows.  
28       Dry-year flows can be higher in regulated streams than in unregulated streams because of release of  
29       carryover storage from reservoirs. Winter and spring peak flows, and summer and fall base flows  
30       are important to maintain ecological processes such as sediment transport, stream meandering, and  
31       riparian habitat regeneration. Native fish species evolved with these flow patterns, and spawning  
32       and migrating fish depend on the natural seasonal and interannual streamflow patterns. Native  
33       habitats and species in the watershed's ecosystem evolved in the context of a highly variable flow  
34       regime punctuated by extreme seasonal and interannual changes in flow (CALFED Bay-Delta  
35       Program 2000a).

36       The volume and distribution of water in the watershed influence important ecological processes and  
37       functions. The natural hydrograph in the watershed is extremely variable with most of the  
38       unimpeded flow occurring from December through June during relatively short periods, caused  
39       either by rainfall or snowmelt. Native fish species evolved with these flow patterns, and spawning  
40       and migrating fish depend on naturally variable seasonal and interannual streamflow patterns for  
41       maintenance of the habitat conditions needed to successfully complete their life cycles (CALFED

1 Bay-Delta Program 2000a). Construction and operation of dams on major rivers and streams has  
2 reduced peak winter and spring flows and increased summer and fall flows, altering the natural  
3 processes that sustain these habitats (e.g. sediment transport, stream meandering, and riparian  
4 regeneration) and creating more stable hydrologic conditions favored by non-native species. River-  
5 transported sediments are an essential component of the physical structure and nutrient base of the  
6 Bay-Delta ecosystem and its riverine and tidal arteries. The coarse sediment supply is highly  
7 variable between the streams and tidal sloughs of the Sacramento and San Joaquin Rivers and Bay-  
8 Delta ecosystems. Most sediment is transported and deposited during winter and spring runoff  
9 events. Typically, bars, shoals, and braided deltas form or expand as floodwaters decline and  
10 stabilize during the dry season. Due to the construction of reservoirs on the major rivers in the  
11 watershed, sediment transport to the lower rivers below the reservoirs has been reduced.

12 Stream meander is a dynamic natural process, and is also a term used to describe the shape of the  
13 river as a sinuous or bending wave form. Rivers with active stream channel meander zones  
14 generally support a greater diversity of aquatic and terrestrial habitats and biotic communities.  
15 Central Valley streams have been affected by physical modifications that diminish stream  
16 meandering and associated aquatic and riparian habitats. However, substantial reaches of several  
17 large rivers still support full or partial characteristics of a dynamic stream meander pattern. The  
18 best example in California is the Sacramento River between Red Bluff and Butte City. Other  
19 important examples include the San Joaquin River (from Mossdale to Merced River); the Merced,  
20 Tuolumne, Cosumnes, Feather, and Yuba Rivers; and Cottonwood, Stony, and Cache Creeks.

21 Floodplains and flood processes provide important seasonal habitat for fish and wildlife, and  
22 provide sediment and nutrients to both the flooded lands and aquatic habitats of the rivers and Bay-  
23 Delta. Today, mostly primary open water channels remain, lacking floodplains, are bordered by  
24 steep-sided riprapped levees often lacking in native vegetation. The Delta waterways generally  
25 contain freshwater, with brief incursions of slightly brackish water into the northern and western  
26 Delta. The major incursions of brackish water into the legal Delta have occurred in the fall (Feyrer et  
27 al. 2007; Cloern and Jassby 2012); they are very rare during spring. Delta hydrodynamics are  
28 determined by a combination of flow parameters including Delta inflow, Delta diversions, tidal  
29 flows, and facility operations (e.g., operation of the Delta Cross Channel [DCC] gates). Cross-Delta  
30 water flow to the south Delta pumping plants reduces residence time of water in the Delta and alters  
31 flow direction and magnitude (Arthur et al. 1996; Kimmerer and Nobriga 2008).

32 Plant contributions to the estuary food web consist mostly of benthic algae and phytoplankton  
33 produced in the estuary and its watershed. The watershed food web is subject to seasonal and  
34 annual trends in response to variation in hydrologic and other environmental factors. The  
35 proportion of the organic material that moves through the Delta and reaches Suisun Bay varies  
36 considerably from year to year and depends, in part, on prevailing flow conditions. At higher flows,  
37 much of the organic material brought in by the rivers will travel to Suisun Bay or farther  
38 downstream to San Pablo Bay or central San Francisco Bay. At low flows, a greater proportion  
39 remains in the Delta or is exported from the South Delta pumping plants (Jassby and Cloern 2000).

40 For detailed discussion of water flow and hydrodynamics refer to Chapter 6, *Surface Water*.

#### 41 **11.1.4.2 Carbon and Nutrient Cycling**

42 Changes in carbon and nutrient cycling in the Delta have occurred over the past decades. A decline  
43 in important fish species in the Delta was identified around 2000, and has been attributed to a wide

1 array of factors related to agricultural, waste water treatment plant, and contaminant discharges  
2 along with changing flow patterns (Ballard et al 2009; Baxter et al 2010; Glibert 2010; and others).  
3 This decline is widely known as the pelagic organism decline (POD). Recognizing that the flow of  
4 energy through the Delta food web is complex and poorly understood, some researchers have  
5 identified a shift at the primary production level from diatom blooms to other, lower quality food  
6 sources (Glibert 2010, 2011; Dugdale et al, 2007; Wilkerson et al 2006). In particular, these  
7 researchers have reported that increased levels of ammonium could inhibit diatom growth, thus  
8 providing a lower quality, less preferred food chain to support fish. Unlike many degraded water  
9 bodies, the Delta has not recently experienced extended algal blooms or hypoxia. Researchers have  
10 noted a shift in algal composition in the increase in cyanobacterium *Microcystis aeruginosa*, increase  
11 in flagellates, and decreases in diatoms (Lehmann et al 2005, 2008; Lehmann 1996; Brown 2010).

12 The primary source of Delta organic carbon is upstream tributaries (Jassby and Cloern 2000).  
13 Secondary sources are phytoplankton and bacterial production and agricultural drainage in the  
14 Delta. Most of the agricultural drainage organic carbon comes from Delta peat soils (Jassby et al.  
15 2003). Other sources include waste water treatment plant discharges and exports from tidal marsh  
16 areas and Yolo Bypass.

17 Although substantial wetland acreage remains in Suisun Marsh, much of the area is no longer tidally  
18 active because it is diked and isolated from tidal influences. Carbon and nutrient exchange with the  
19 surrounding waterways is therefore reduced in Suisun Marsh.

20 Most of the historic floodplain in the Delta has been converted to agricultural fields, including  
21 farmed wetlands (rice fields), or to wetlands managed for waterfowl habitat. Therefore, the tidal  
22 exchange of carbon and nutrients between wetlands and open water has been reduced. Periodic  
23 flooding of the Yolo Bypass still contributes to carbon and nutrient cycling, which provides  
24 important ecosystem functions (Sommer et al. 2001). Accidental and intentional levee breaches and  
25 floodplain flooding, such as the Liberty Island levee breach in the 1990s, has reconnected large  
26 tracts of historic floodplain with the Delta, thereby increasing the carbon and nutrient exchange  
27 levels in recent years.

### 28 **11.1.4.3 Biodiversity**

29 The conversion of original Delta habitat to diked and drained farm fields separated by wide open-  
30 water channels has substantially reduced the species diversity of the Delta. In Suisun Marsh, there is  
31 a predominance of diked, managed wetlands. The wetlands of Suisun Marsh still provide habitat for  
32 a diverse assemblage of waterfowl species (see Chapter 12, *Terrestrial Biological Resources*, for  
33 additional information on the biological resources in Suisun Marsh). However, there are biological  
34 trade-offs between water fowl and listed fish species, as the managed wetlands also result in water  
35 quality violations that have negative, sometimes fatal, effects on aquatic species.

36 The Yolo Bypass was historically a vast mosaic of natural vegetative communities, including large  
37 areas of seasonally flooded wetlands and riparian habitat (California Department of Fish and Game  
38 and Yolo Basin Foundation 2008). Because of seasonal and annual climatic variations, the habitats  
39 were highly dynamic. Hydrologic variability was reduced following construction of upstream dams  
40 on the Sacramento River, its tributaries, and Putah and Cache creeks. As was discussed for the Delta,  
41 the building of levees disconnected floodplains from the active stream channels, while agricultural  
42 land conversion reduced wetland and riparian habitat area (California Department of Fish and Game

1 and Yolo Basin Foundation 2008). Overall, the biodiversity of species that could be supported by the  
2 Yolo Bypass was also reduced.

3 The current assemblages of fish in the watershed include a mixture of native and introduced species.  
4 Although there is limited knowledge of the ecology of native fishes in the past, the historical  
5 assemblages of fish upstream of and in the Delta were very different from the current assemblages  
6 (California Department of Water Resources 2013). For example, thicketail chub became extinct in the  
7 1950s (California Department of Water Resources 2013). Also, the Sacramento perch, once  
8 abundant in sloughs off main channels, was extirpated from the Delta (Rutter 1908). Conversely, a  
9 large number of nonnative species of fish have been either intentionally (e.g., striped bass, channel  
10 catfish, American shad, threadfin shad, and largemouth bass) or unintentionally (e.g., goldfish)  
11 introduced into the system. Further, the abundance of many native fishes was much greater  
12 historically than currently. For example, Chinook salmon were once very abundant throughout the  
13 watershed, but today their abundance is relatively low. Similarly, other native anadromous fish  
14 populations, including sturgeon, and native resident fish populations, such as delta smelt and  
15 Sacramento splittail, have been substantially reduced in numbers and range. Populations of native  
16 invertebrates, such as the mysid shrimp, the amphipod, and cyclopoid copepods (Moyle 2002), have  
17 been replaced as dominant species by multiple nonnative species (Sommer 2007).

#### 18 **11.1.4.4 Aquatic Communities**

##### 19 **Phytoplankton**

20 Phytoplankton primary productivity in the Delta has experienced a long-term decline, and is  
21 currently low relative to other estuaries (Baxter et al. 2010; Cloern and Jassby 2008). As discussed  
22 in the previous section on nutrients, the phytoplankton assemblages have changed over the past  
23 decades (Glibert 2010, 2011; Dugdale et al, 2007; Wilkerson et al 2006). Changes in nutrient ratios  
24 (N:P) and ammonia from waste water treatment plant discharges have been identified as causes of  
25 the shift in phytoplankton assemblages. Once diatom-based, phytoplankton has shifted to smaller-  
26 celled organisms including cyanobacteria *Microcystis aeruginosa* and flagellates, which have low  
27 nutritional value for Delta zooplankton, relative to nutritionally superior diatoms (Baxter et al.  
28 2010).

29 In addition to the phytoplankton assemblage changes, overall reduction in chlorophyll-a in the  
30 water column has also been observed, and linked to changes in the ratio of nitrogen to phosphorous  
31 (Glibert 2010). Phytoplankton biomass (measured as chlorophyll-a) was high in the 1970's, but  
32 decreased in the mid-1980's. the decrease is attributed to both changes in the ratios of nitrogen,  
33 phosphorous and carbon, and the increase in the invasive clam (*Corbula amurensis*) which is a  
34 highly effective filterer of phytoplankton from the water column (Glibert 2011). The impact of  
35 *Corbula* is markedly high Susuin Bay, where the clam has flourished.

##### 36 **Zooplankton**

37 Zooplankton assemblages changed in the 1980's coincident with phytoplankton changes. Generally,  
38 the calanoid copepods and harpacticoid copepods have decreased, and the cyclopoid and invasive  
39 calanoid copepod species have increased (Glibert 2011). In the 1970's, Calanoid copepods  
40 *Eurytemora affinis* and *Acartia Clausii* were dominant. Copepod species assemblages began to shift  
41 in the 1980's. The calanoid copepod *Sinocalanus doerrii* first appeared, followed by the exotic  
42 *Pseudodiaptomis forbesi* and the invasive *Limnoithona tetraspina* (Glibert 2011). Increased

1 abundance of the copepod *Pseudodiaptomis* coincided with the increase of the invasive clam *Corbula*  
 2 *amurensis* in Suisun Bay in 1987. The abundance of cladocerans *Bosmina longirostris* and *Daphnia*  
 3 sp. also increased significantly in the late 1980's through the 1990's (Glibert 2011).

#### 4 **11.1.5 Stressors**

5 Stressors are actions, environmental characteristics or organisms that may negatively affect fish and  
 6 aquatic resources, ecological processes, and habitats. An overview of stressors to fish and aquatic  
 7 resources is first presented by geographic area (i.e., upstream of the Plan Area, the Plan Area, and  
 8 downstream of the Plan Area). More detailed discussions regarding species-, run-, and life stage-  
 9 specific stressors are provided in Appendix 11A.

10 Numerous documents were reviewed to identify stressors affecting fish and aquatic resources in the  
 11 watershed. These documents include the draft BDCP Habitat Conservation Plan (HCP)/Natural  
 12 Community Conservation Plan (NCCP), the Delta Regional Ecosystem Restoration Implementation  
 13 Plan (DRERIP) Conceptual Models, the MSCS, the 2009 NMFS BiOp (National Marine Fisheries  
 14 Service 2009a), the U.S. Fish and Wildlife Service (USFWS) BiOp (U.S. Fish and Wildlife Service  
 15 2008), NMFS and USFWS species recovery plans, primary literature, agency technical memoranda,  
 16 and others. Common to many of these documents was the identification of major categories of  
 17 stressors that negatively affect fish and aquatic species, ecological processes, and habitats within the  
 18 watershed, including (1) water development and conveyance; (2) water quality, contaminants, and  
 19 toxicity; (3) nonnative aquatic resources; (4) harvest and hatchery management; and (5)  
 20 recreational and commercial activities.

##### 21 **11.1.5.1 Water Development and Conveyance**

22 Current hydrodynamic conditions within the Delta act as ecosystem stressors by affecting species  
 23 movement among habitats, limiting habitat availability and suitability, creating conditions favoring  
 24 nonnative invasive species, and limiting food production. SWP and CVP exports have direct and  
 25 indirect effects on fishes in the Delta. Specifically, exports entrain fish, alter hydrodynamics, and  
 26 affect food webs. A full description of the export facilities is included in Chapter 5, *Water Supply*. A  
 27 brief overview of the facilities is described below for reference.

28 The amount and timing of water exports from the Delta affects the level of entrainment. These  
 29 hydrodynamic conditions affect water quantity and quality due to higher water velocities and  
 30 reduced residence time, which alter various habitat types that are dependent upon natural flow  
 31 patterns. In addition, the rate and location that water is diverted from the Delta affects the residence  
 32 time of water in Delta channels that, in turn, affects primary and secondary production (California  
 33 Department of Fish and Game 2008b).

##### 34 **Water Diversions**

35 The SWP and CVP export facilities in the south Delta are the largest water diversions in the estuary.  
 36 Additionally, a power plant in Pittsburg diverts water for its operations, and several diversions  
 37 supply water to Contra Costa Water District, as well as to cities on the periphery of the Delta  
 38 (California Department of Fish and Game 2008b). A detailed description of the SWP and CVP  
 39 facilities is provided in Chapter 5, *Water Supply*.

40 The SWP and CVP use the Sacramento River and channels in the Delta to transport water from  
 41 upstream tributaries and reservoirs to the SWP Harvey O. Banks Pumping Plant (Banks Pumping

1 Plant) and the CVP C. W. Jones Pumping Plant (Jones Pumping Plant) in the south Delta, as described  
2 in Chapter 5, Water Supply. Both pumping plants have associated fish collection facilities that are  
3 described below.

#### 4 **CVP and SWP Entrainment and Salvage Operations**

5 Entrainment of Delta fish in water diversions has been an important focus for scientific investigation  
6 in the Delta and a key consideration for management of water operations and fish conservation. The  
7 south Delta SWP and CVP facilities are the largest water diversions in the Delta, and have been the  
8 subject of most scientific investigation and management actions relating to entrainment. In the past,  
9 these facilities have entrained large numbers of Delta fish species. Before fish reach the CVP and  
10 SWP facilities, there are other ways mortality occurs. Pre-screen mortality can occur in Old River  
11 when emigrating smolts from the San Joaquin River become diverted and drawn into the south Delta  
12 export facilities (Larry Walker Associates 2010). For example, between 1979 and 1993 up to  
13 435,000 juvenile Chinook salmon and 56,000 delta smelt were salvaged annually at the SWP south  
14 Delta fish facility (Brown et al. 1996). The actual entrainment losses were likely an order of  
15 magnitude greater than measured salvage, due to predation in Clifton Court Forebay and the  
16 relatively low diversion efficiency of the louver fish exclusion system (the percentage of fish that are  
17 successfully directed to holding tanks and counted) (Brown et al. 1996; Castillo et al. 2012, Castillo  
18 et al. in review). Entrainment by agricultural diversions also occurs (Nobriga et al. 2004) but is not  
19 believed to be as substantial because of the small size of these intakes, although predation levels in  
20 the vicinity of the structures may be high (Vogel 2011).

21 In recent years, entrainment of pelagic species (e.g., delta smelt and longfin smelt) and other Delta  
22 fish from the south Delta facilities has been substantially reduced due to changes in export  
23 operations as well as declining abundance of some fish such as delta smelt (Kimmerer 2011).

24 Figure 11-1 compares total monthly and annual CVP and SWP salvage for several covered fish  
25 species (delta smelt, longfin smelt, Chinook salmon and splittail) from 1991 through 2010. Salvage is  
26 a variable proportion of entrainment, the actual proportion depending on louver efficiency, pre-  
27 screen loss levels, and many other factors, but is considered a reasonable index of total entrainment.  
28 Actual entrainment is always appreciably greater than salvage. Chinook salmon and delta smelt have  
29 a clear pattern of entrainment with peak salvage levels in 1999 and 2000 but a sharp decline in  
30 more recent years.

31 The monthly and annual salvage varies from year to year because of changes in pumping and  
32 changes in the density of fish (number of fish per unit volume of water) in the vicinity of the  
33 diversions. Splittail and longfin smelt have shown high levels of salvage in some years. For example,  
34 large numbers of larval and juvenile splittail are entrained at the south Delta facilities during wet  
35 years, when splittail abundance is high, compared to low entrainment levels in dry years. The  
36 increased entrainment during wet years is a result of increased availability of inundated floodplain  
37 habitat and greater recruitment of young splittail. Conversely, entrainment of longfin smelt can be  
38 higher in dry years because the distribution of longfin smelt shifts further upstream and closer to  
39 the south Delta facilities (Sommer et al. 2007). Salvage has a seasonal pattern as well, with salvage of  
40 all four species concentrated in March through May.

41 These graphs show that, as noted above, the number of fish salvaged at CVP and SWP in recent years  
42 is greatly reduced from previous levels. This presumably reflects reduced abundance of fish, various  
43 pumping restrictions, and the use of new management techniques for avoiding entrainment through  
44 the monitoring of turbidity events and management of OMR flows in the Central Delta. Nonetheless,

1 entrainment remains a focus of regulatory concern because of its potential to affect fish populations.  
2 Thus, a key part of the EIR/EIS and BDCP Effects Analyses evaluates effects on entrainment.

3 Entrainment of fish does not necessarily mean they are killed. The fish salvage systems at the CVP  
4 Tracy Fish Facility and the SWP Skinner Fish Facility divert a portion of fish into a salvage system for  
5 collection and return to the Delta. These systems were designed primarily to salvage juvenile  
6 salmon and other fairly robust fish. Though delta smelt can survive the salvage process, they are  
7 more fragile and suffer greater mortality (Morinaka 2010). For the remainder of listed fish species,  
8 the proportion of fish killed by entrainment depends on factors such as predation and louver  
9 screening efficiency. Louver efficiency is 75% SWP and 47% at CVP (National Marine Fisheries  
10 Service 2009).

11 Because of the difficulty associated with estimating total population size of the Delta fish species,  
12 most analysts have estimated fish entrainment as a proportion of population indices assuming that  
13 this proportionality applies to the population as well. Kimmerer (2008) estimated the loss of larval  
14 and juveniles for the years 1995 to 2006 at between 0 and 26% of the larval and juvenile population  
15 and from 1 to 22% of the adult delta smelt population, giving a total population loss of 1–38%  
16 (Miller 2011). Miller (2011) reanalyzed and updated Kimmerer’s analysis and concluded that a  
17 lower proportion of the delta smelt population (i.e., up to 15–30%) was lost to entrainment at the  
18 south Delta pumps than estimated by Kimmerer (2008). Kimmerer (2011) concurred with some  
19 points of Miller’s reanalysis but also noted that the reduced proportions in recent years may reflect  
20 reduced abundance of delta smelt in the south Delta. While there is some uncertainty surrounding  
21 the proportion of the population that is lost to entrainment, both analyses indicate that appreciable  
22 proportions of the overall population of delta smelt may have been lost in some years.

23 The numbers and proportions of covered species such as delta smelt and listed Chinook salmon  
24 entrained in the south Delta pumps have been a consistent management concern, which has resulted  
25 in significant modification of regional water operations (U.S. Fish and Wildlife Service 2008;  
26 National Marine Fisheries Service 2009). Several recent analyses, have demonstrated some reason  
27 for concern related to entrainment loss of covered fish species.

- 28 ● Mac Nally et al. (2010) found weak statistical evidence for a negative relationship between fall  
29 abundance of delta smelt and spring south Delta exports (i.e., larval/juvenile entrainment) or  
30 winter south Delta exports (i.e., adult entrainment).
- 31 ● Thomson et al. (2010) found that winter exports had a high probability of inclusion in models  
32 explaining variation in delta smelt abundance but could not explain the step change in  
33 abundance during the Pelagic Organism Decline (POD) of the 2000s.
- 34 ● Maunder and Deriso (2011) found some statistical support for a statistical model of factors  
35 affecting delta smelt that included estimates of adult entrainment, although as discussed in  
36 Appendix 5.G, *Fish Life Cycle Models* of the *BDCP Effects Analysis*, other competing models  
37 without adult entrainment included explain variations in delta smelt abundance more  
38 efficiently.
- 39 ● Miller et al. (2012) found that survival of delta smelt from fall to summer was statistically  
40 negatively associated with total proportional entrainment of delta smelt (i.e., adults and  
41 larvae/juveniles from the next generation), although survival from fall to fall (i.e., the full life  
42 cycle) was not related to total entrainment.

- 1 Newman and Brandes (2010) found that Chinook salmon smolts released in the interior Delta  
2 (Georgiana Slough) had relatively lower through-Delta survival than smolts released in the  
3 Sacramento River, and that the relative survival became lower as south Delta exports increased;  
4 a form of this relationship is included in the Delta Passage Model (Appendix 5.C, *Flows, Passage,*  
5 *Salinity, and Turbidity of the BDCP Effects Analysis*) and the Interactive Object-Oriented  
6 Simulation Model (IOS) winter-run Chinook salmon life cycle model (see Appendix 5.G, *Fish Life*  
7 *Cycle Models of the BDCP Effects Analysis*).
- 8 The Oncorhynchus Bayesian Analysis (OBAN) salmon life cycle model (described in more detail  
9 in Appendix 5.G, *Fish Life Cycle Models of the BDCP Effects Analysis*) demonstrated a significant  
10 negative relationship between winter-run Chinook salmon through-Delta survival and south  
11 Delta exports.

12 Analyses and statistical models have also pointed to multiple stressors other than entrainment that  
13 could explain the recent population declines in delta smelt and other pelagic fish species (Baxter et  
14 al. 2010; Maunder and Deriso 2011).

15 The relative importance of entrainment and other attributes was evaluated by a group of regional  
16 scientists through a series of conceptual models published by the DRERIP<sup>1</sup>. The DRERIP models  
17 provide a conceptual view of the life history and habitat requirements of the species and a subjective  
18 ranking of stressors for the species. It is important to note that the DRERIP conceptual models  
19 generally were written prior to the 2008 and 2009 USFWS and NMFS BiOps (U.S. Fish and Wildlife  
20 Service 2008; National Marine Fisheries Service 2009a) and do not reflect the less negative flows in  
21 Old and Middle River or export reductions intended to reduce the effects of entrainment at the south  
22 Delta export facilities. The DRERIP model for delta smelt developed by Nobriga and Herbold (2009)  
23 ranked water exports (entrainment) and water transparency as the most important stressors on  
24 delta smelt at that time; food, competition and ecosystem effects also received high rankings. These  
25 rankings have not been updated to reflect the operational changes in pumping at the south Delta  
26 facilities. Williams (2010) discusses entrainment of juvenile Chinook salmon and steelhead at the  
27 pumps as being difficult to assess. While total numbers of salmonids are counted at salvage, it is  
28 unknown how many are lost to predation near the pumps or that bypass the collection facilities. Use  
29 of tagged hatchery fish to estimate survival versus naturally produced fish may also affect results  
30 because hatchery fish may suffer higher mortality rates than natural fish. There also may be an  
31 “indirect” mortality associated with modified circulation patterns or other conditions related to the  
32 pumps.

33 The DRERIP rankings as well as the quantitative analyses such as those of Kimmerer (2008, 2011)  
34 and Miller (2011), while reflecting different assumptions and approaches, converge on a conclusion  
35 that entrainment of large numbers of covered fish species has occurred in the past during periods of  
36 high water exports from the CVP and SWP facilities. The importance of entrainment to short- and  
37 long-term population dynamics of delta smelt is not yet clear. It is also noted that the number of fish  
38 entrained has declined in recent years, which could be a result of decreasing populations as well as  
39 improved water operations management. Because entrainment is a function of water exports, it will  
40 continue to receive close scrutiny and a focus of efforts to reduce impacts of water operations on  
41 fish.

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<sup>1</sup> <[http://www.dfg.ca.gov/ERP/conceptual\\_models.asp](http://www.dfg.ca.gov/ERP/conceptual_models.asp)>.

## **In-Delta Agricultural Diversions**

Approximately 2,200 water diversions are located in the Delta (Herren and Kawasaki 2001; U.S. Bureau of Reclamation 2008a; Bay Delta Conservation Plan 2008). Chapter 14, *Agricultural Resources*, describes agricultural diversion locations and operations in detail. The majority of the diversions divert water to agricultural fields between April and August, depending on the crop. The early part of this irrigation season coincides with the presence of juveniles of all nine covered fish species in the Delta (Bay Delta Conservation Plan 2008).

Entrainment by agricultural diversions is not frequently identified as a factor in the decline of Delta fisheries resources (e.g., delta smelt) (Bureau of Reclamation 2008a). However, Herren and Kawasaki (2001) report that over 95% of these small water diversions are not screened to reduce fish entrainment. These diversions are often located in small channels, potentially increasing the influence of the diversion on the channel relative to channel capacity. Hence, the potential for substantial entrainment of fish is high (Hallock and Van Woert 1959).

The shoreline location and timing of most agricultural diversions also may contribute to effects on Delta fisheries resources. Delta smelt spawning is thought to occur in shallow and shoreline waters from February through June, although spawning locations vary depending on hydrological conditions and temperature (Bennett 2005). Agricultural diversions are mostly active from late spring through fall when water is needed for spring and summer crops (Brown 1982), which overlaps with the spring spawning cycle of delta smelt and the subsequent appearance of yolk-sac larvae and larval delta smelt. These early life stages possess limited motility and are located in the shallow and shoreline waters in which they hatched (Bureau of Reclamation 2008a).

Because spawning and larval development are likely to occur in shallow shoreline locations and movement is limited, entrainment of these life stages by agricultural diversions may be more substantial (Bureau of Reclamation 2008a). To date, entrainment by agricultural in-Delta diversions has been evaluated in several studies. Cook and Buffaloe (1998 as cited in Nobriga et al. 2004) found that a large diversity of fish species can be entrained by small agricultural diversions in the Delta, especially YOY fish present from May through August. Limited studies conducted by Nobriga et al. (2004) indicate that self-cleaning screens have been at least 99% effective in reducing fish entrainment at non-project diversions, even for larval fishes less than 25 mm (about 1 inch). However, there is evidence that unscreened diversions entrain large numbers of nonnative species (Brown 1982; Nobriga et al. 2004). Therefore, screening diversions could be more beneficial to nonnative fish species than native fish species, potentially increasing competition with and predation by nonnatives on natives.

## **In-Delta Power Plant Diversions**

Although the old Contra Costa County Power Plant at Antioch has recently closed, the Pittsburg Power Plant continues to operate using river water diversions for once-through cooling systems in the Delta. A detailed description of the in-Delta power plant locations and operations is provided in Chapter 20, *Public Services and Utilities*. Once-through cooled electrical generating plants in the Delta can impinge and entrain fish and aquatic organisms, including pelagic organisms and threatened and endangered species. These plants also could have other effects related to thermal discharges. Over time, these power plants have reduced their operations and currently only operate at the direction of the California Independent System Operator when additional power is needed to avoid power outages, primarily during the summer when Delta fisheries concerns are reduced.

1 Recently, the capacity utilization rates for these plants have been between 5 and 10% (State Water  
2 Resources Control Board et al. 2008).

3 The assessment and reduction of entrainment at the Contra Costa (intake no longer active) and  
4 Pittsburg Power Plants were identified as a measure to reduce impacts on pelagic organisms in the  
5 Delta (California Department of Water Resources and California Department of Fish and Game  
6 2007). Mirant Delta LLC (Mirant) is currently working with CDFW to obtain an updated incidental  
7 take permit pursuant to CESA, a process that will require additional monitoring and evaluation of  
8 species entrainment and identification of avoidance and mitigation measures necessary to address  
9 the level of take. In addition, Mirant is participating in the BDCP in an effort to address the impacts  
10 of operations of their facilities. Establishment of updated requirements to ensure the protection of  
11 fish at power plant diversions has been identified as an element of the State Water Board's 2008  
12 Strategic Workplan (State Water Resources Control Board et al. 2008).

13 In the 1950s, CDFW estimated that as many as 19 million small striped bass might pass through and  
14 be killed at the Contra Costa Power Plant each year between April and mid-August (Matica and  
15 Sommer 2005). In 1979, the total average annual entrainment of smelt species, Sacramento splittail,  
16 and salmon was estimated to be 86 million, 345,000, and 24,000, respectively. The total average  
17 annual impingement for smelt, Sacramento splittail, and salmon was estimated to be 178,000,  
18 21,000, and 2,600, respectively (Matica and Sommer 2005). It is unclear whether these numbers are  
19 relevant to current entrainment trends, because populations of smelt are highly variable and power  
20 plant operations have been reduced such that the plants operate only to meet peak power needs  
21 (Matica and Sommer 2005).

22 A total of 331 fishes comprised of nine species and one taxon group were collected during  
23 entrainment sampling at the Contra Costa Power Plant Units 6 and 7 intakes from March 7, 2008,  
24 through July 8, 2008 (Mirant 2009). Six species and one taxon group comprised 99% of all fish  
25 collected at that intake. Prickly sculpin was the most abundant fish species (49%), followed by  
26 striped bass (16%), Pacific herring (13%), unidentified gobies (12%), threadfin shad (5%), delta  
27 smelt (4%), and longfin smelt (1%) (Mirant 2009). The old Contra Costa Power Plant was replaced  
28 by a new plant that uses water cools with water provided by the Antioch and Delta Diablo  
29 Sanitation District for cooling, thereby avoiding the entrainment of fish.

30 A total of 539 fish comprised of eight species and one taxon group were collected during  
31 entrainment sampling at the Pittsburg Power Plant from March 7, 2008, through July 8, 2008.  
32 Almost all of these fish (92.2%) were Pacific herring. Three other species and 1 taxon group  
33 comprised another 6.7% of fish collected: gobies (2.8%), prickly sculpin (2.6%), longfin smelt  
34 (0.7%), and delta smelt (0.6%) (Mirant 2009).

### 35 **Refuges and Hunting Reserves**

36 Refuges, wildlife preserves, and hunting reserves along the Sacramento River and in the Delta and  
37 Suisun Marsh (see Chapter 12, *Terrestrial Biological Resources*; Chapter 13, *Land Use*; and  
38 Chapter 15, *Recreation*) provide habitat for resident and migratory waterfowl, threatened and  
39 endangered species, and wetland-dependent aquatic biota. Water supplies for certain wildlife  
40 refuges in the Central Valley are administered through Central Valley Project Improvement Act  
41 (CVPIA) programs that acquire and convey water. Reclamation has obligations under the CVPIA to  
42 provide Incremental Level 4 refuge water supply, and water for some of these areas is acquired  
43 through water supply contracts with "willing sellers."

## 1 **Suisun Marsh Facilities**

2 Several facilities have been constructed by DWR and Reclamation to provide lower-salinity water to  
3 managed wetlands in the Suisun Marsh. The Suisun Marsh facilities, including the Roaring River  
4 Distribution System, Morrow Island Distribution System, and Goodyear Slough Outfall, were  
5 constructed in 1979 and 1980. The Suisun Marsh Salinity Control Gates were installed and became  
6 operational in 1988. Other facilities constructed under the Suisun Marsh Preservation Agreement  
7 include the Cygnus Drain and the Lower Joice Island Diversion. Refer to Chapter 5, *Water Supply*, for  
8 further descriptions of the facilities and their operations. Suisun Marsh facilities with the potential  
9 to entrain fish and aquatic resources are described below.

### 10 ***Roaring River Distribution System***

11 The intake to the Roaring River Distribution System is screened to prevent entrainment of fish  
12 larger than approximately 25 mm (approximately 1 inch). DWR designed and installed the screens  
13 using CDFW criteria. Each screen is a stationary vertical screen, constructed of continuous-slot  
14 stainless steel wedge wire. All screens have 3/32-inch slot openings. After the listing of delta smelt,  
15 Roaring River Distribution System diversion rates have been controlled to maintain an average  
16 approach velocity below 0.2 ft./sec at the intake fish screen. Initially, the intake culverts were held at  
17 about 20% capacity to meet the velocity criterion at high tide (Bureau of Reclamation 2008a).

### 18 ***Morrow Island Distribution System***

19 The Morrow Island Distribution System is used year-round, but most intensively from September  
20 through June. When managed wetlands are filling and circulating, water is tidally diverted from  
21 Goodyear Slough just south of Pierce Harbor through three 48-inch culverts. Drainage water from  
22 Morrow Island is discharged into Grizzly Bay by way of the C-Line Outfall (two 36-inch culverts) and  
23 into the mouth of Suisun Slough by way of the M-Line Outfall (three 48-inch culverts) rather than  
24 back into Goodyear Slough (Bureau of Reclamation 2008a).

25 The 1997 USFWS BiOp issued for dredging of the facility included a requirement for screening the  
26 diversion to protect delta smelt (Bureau of Reclamation 2008a). Due to the high cost of fish screens  
27 and the lack of certainty surrounding their effectiveness at the Morrow Island Distribution System,  
28 DWR and Reclamation proposed to investigate fish entrainment at the intake and to evaluate  
29 whether screening the diversion would provide substantial benefits to local populations of listed  
30 fish species. DWR staff monitored fish entrainment from September 2004 to June 2006 at the  
31 Morrow Island Distribution System in Suisun Marsh to evaluate entrainment losses at the facility.  
32 Monitoring took place over several months under various operational configurations to provide data  
33 on the site-specific impact of the diversion, with a focus on delta smelt and salmonids. Over  
34 20 different species were identified during the sampling, yet only two fall-run-sized Chinook salmon  
35 (South Intake 2006) and no delta smelt from entrained water were caught (Bureau of Reclamation  
36 2008a). Two species that associate with instream structures, threespine stickleback and prickly  
37 sculpin, comprised most of the entrained fish (Bureau of Reclamation 2008a).

### 38 ***Goodyear Slough Outfall***

39 The Goodyear Slough Outfall was constructed to increase circulation and reduce salinity in Goodyear  
40 Slough by draining water from the southern end of the slough into Suisun Bay. The system also  
41 provides lower-salinity water to the wetland managers who flood their ponds with Goodyear Slough  
42 water. The system is open for free fish movement except very near the outfall when flap gates are

1 closed during flood tides. Any fish moving from Goodyear Slough into the outfall would end up in  
2 Suisun Bay (Bureau of Reclamation 2008a).

### 3 **Lower Joice Island Unit**

4 The Lower Joice Island Unit consists of two 36-inch-diameter intake culverts on Montezuma Slough  
5 near Hunter Cut and two 36-inch-diameter culverts on Suisun Slough, also near Hunter Cut. The  
6 culverts were installed in 1991. The facilities include combination slide/flap gates on the slough side  
7 and flap gates on the landward side. In 1997, DWR contracted with the Suisun Resource  
8 Conservation District to construct a conical fish screen on the diversion on Montezuma Slough.  
9 Installation of the Lower Joice Island Fish Screen allows for year-round management of wetlands  
10 inside the island's perimeter levee (U.S. Fish and Wildlife Service 2000b).

### 11 **Cygnus Unit**

12 The Cygnus Unit is a 36-inch drain gate with flashboard riser that was installed in 1991 on a private  
13 parcel located west of Suisun Slough, and adjacent and south of Wells Slough. The property owner is  
14 responsible for operation and maintenance of the gate (California Department of Water Resources  
15 2000).

## 16 **11.1.5.2 Hydrograph and Hydrodynamic Alterations**

17 This section describes the effects of hydrograph alterations in the Delta aquatic ecosystem resulting  
18 from water diversions, integrated SWP and CVP operations, and development in the watersheds  
19 upstream of the Delta. The various hydrodynamic influences affecting regions of the Delta may  
20 fluctuate (see Chapter 6, *Surface Water*). However, in general, the following conditions apply: (1) the  
21 west Delta is dominated by strong tidal inflows, which frequently result in reverse flows; (2) the  
22 north Delta is more influenced by inflows from the Sacramento and Mokelumne Rivers; (3) the  
23 south Delta is primarily affected by export pumping and inflows from the San Joaquin River; and (4)  
24 the central Delta is affected by a combination of these factors (refer to Chapter 6, *Surface Water*, for  
25 further discussion of Delta hydrodynamics). A detailed description of SWP and CVP operations and  
26 the effects of water development and conveyance on hydrodynamics is presented in Chapter 5,  
27 *Water Supply*.

### 28 **Delta Inflow**

29 Total Delta inflow includes the sum of Yolo Bypass, Sacramento River, Mokelumne River, Calaveras  
30 River, Cosumnes River, and San Joaquin River outflows (Bureau of Reclamation 2008a). The  
31 Sacramento River (including the Yolo Bypass) contributes about 77 to 85% of the freshwater  
32 inflows to the Delta, while the San Joaquin River contributes about 10 to 15%. The minor  
33 contribution of flows from the Mokelumne, Cosumnes, and Calaveras Rivers, which enter into the  
34 eastern side of the Delta, contribute most of the remainder of the Delta inflow. The highest Delta  
35 inflows occur from January through April due to floodflows (Bureau of Reclamation 2008a). Detailed  
36 discussion of SWP and CVP operations and natural hydrology effects on Delta inflow are described  
37 in Chapter 6, *Surface Water*.

### 38 **Delta Outflow**

39 Delta outflow is the primary driver of the salinity gradient in Suisun Bay. Delta outflow controls, in  
40 balance with upstream salinity intrusion from the Bay, the location of the LSZ (Kimmerer 2004;

1 Kimmerer et al. 2009; U.S. Fish and Wildlife Service 2008; National Marine Fisheries Service 2009a).  
2 Delta outflows also affect downstream transport of some species of larval fish and other aquatic  
3 organisms, as well as nutrients and food supplies into the lower reaches of the Delta and Suisun Bay.  
4 As previously discussed under *Pelagic Habitat Areas*, the abundance of many species inhabiting the  
5 Delta is related to water flow timing and quantity and salinity (California Department of Fish and  
6 Game 2010b).

7 Nearly 20% of the total mean Sacramento River outflow occurs between April and June under  
8 current SWP and CVP operations, compared to nearly 50% of the total mean outflow occurring  
9 between April and June during the later portion of the nineteenth century, before the two projects  
10 existed (The Bay Institute 1998; National Marine Fisheries Service 2009a). In all water-year types  
11 (wet, average, dry) the Sacramento River and its tributaries represent the largest flow into the Delta,  
12 followed by the San Joaquin River and then the eastside tributaries such as the Mokelumne and  
13 Cosumnes rivers. Delta outflow varies by water year type. For example, in the above normal 2000  
14 water year more than 70% of water entering the Delta passed through the system as outflow  
15 (Governor's Delta Blue Ribbon Task Force 2008). In the dry 2001 and wet 1998 water year about  
16 54% and 90%, respectively, of the water entering the Delta was outflow (Governor's Delta Blue  
17 Ribbon Task Force 2008).

18 Delta outflow targets have been developed to protect delta smelt and longfin smelt (U.S. Fish and  
19 Wildlife Service 2008; California Department of Fish and Game 2009). To improve delta smelt  
20 habitat, the 2008 USFWS Biological Opinion on the Coordinated Long-term Operation of the CVP and  
21 SWP (2008 USFWS BiOp sets forth targets for managing the location of X2 through increasing Delta  
22 outflow during fall when the preceding water year was wetter than normal (U.S. Fish and Wildlife  
23 Service 2008). Subject to adaptive management, USFWS (2008a) prescribes that sufficient Delta  
24 outflow be provided to maintain average location of X2 for September and October no greater (more  
25 eastward) than 74 km (about 46 miles) in the fall following wet years and 81 km (about 50 miles) in  
26 the fall following above-normal years. The monthly average X2 must be maintained at or seaward of  
27 these values for each individual month and not averaged over the 2-month period. In November, the  
28 inflow to SWP and CVP reservoirs in the Sacramento River Basin will be added to reservoir releases  
29 to provide an added increment of Delta inflow and to augment Delta outflow up to the fall target  
30 (U.S. Fish and Wildlife Service 2008). This action is to be implemented between September 1 and  
31 November 30 (U.S. Fish and Wildlife Service 2008). On-going litigation affected X2 implementation  
32 in 2011. In 2011, the District Court enjoined Reclamation and DWR from implementing Fall X2 at  
33 74km but set the action at no more west than 79 km.

#### 34 ***Old and Middle River Flows***

35 Old and Middle Rivers are two major southern Delta channels that are pathways for export water  
36 moving toward the SWP and CVP pumps in the south Delta. In general, water is conveyed to Banks  
37 Pumping Plant and Jones Pumping Plant via the Old and Middle River channels, resulting in a net  
38 (over a tidal cycle or tidal cycles) flow toward the pumping plants (U.S. Fish and Wildlife Service  
39 2008). When combined water export exceeds San Joaquin River inflows, the additional water is  
40 drawn from the Sacramento River through the DCC, Georgiana Slough, and Threemile Slough (U.S.  
41 Fish and Wildlife Service 2008). At high pumping rates, net San Joaquin River flow is toward Banks  
42 and Jones pumping plants (Arthur et al. 1996). Combined flow in the Old and Middle Rivers is  
43 measured as "OMR" flows, while flow in the San Joaquin River at Jersey Island is calculated as  
44 "Qwest." Flow toward the pumps is characterized as negative flow for both measurements. Further,

1 OMR flow toward the pumps is increased seasonally by installation of the South Delta Temporary  
2 Barriers Project (TBP) (U.S. Fish and Wildlife Service 2008).

3 Decreasing net upstream flows may reduce the chances of migrating juvenile salmonids moving up  
4 lower Old River toward the SWP and CVP diversions. The same is true if the net flows are completely  
5 downstream. Old and Middle River flows that were negative, which were greater than  $-2,000 \text{ cfs} \pm$   
6  $500 \text{ cfs}$ , effectively prevented entrainment of delta smelt that were north of the sampling stations in  
7 Old and Middle Rivers (Bureau of Reclamation 2008a). A linear relationship between delta smelt  
8 salvage and flow exists at flows greater than  $-4,000 \text{ cfs}$  (more seaward flow) (Bureau of Reclamation  
9 2008a) (see delta smelt section under Section 11.1.3, *Fish Species Evaluated*). At flows less than  $-$   
10  $4,000 \text{ cfs}$  (more landward flow) the salvage rate for delta smelt begins to take on an exponential  
11 characteristic. Based on particle tracking modeling, the Delta Smelt Working Group concluded that  
12 net river flows greater than  $-2,000 \pm 500 \text{ cfs}$  in Old and Middle Rivers reduced the zone of  
13 entrainment so that particles injected into the central Delta at Potato Slough would not be entrained  
14 toward the pumps (Kimmerer and Nobriga 2008; U.S. Bureau of Reclamation 2008a). NMFS (2009a)  
15 considered this information useful in analyzing the potential “zone of effects” for entraining  
16 emigrating juvenile and smolting salmonids. A similar pattern is observed in juvenile salmon and  
17 smolt salvage analyses conducted by DWR (National Marine Fisheries Service 2009a). Loss of older  
18 juveniles at the SWP and CVP fish collection facilities increases sharply at Old and Middle River  
19 flows of approximately  $-5,000 \text{ cfs}$  and departs from the initial slope at flows below this. Using the  
20 proposed operational scenario in the Biological Assessment (Reclamation 2008) and given the data  
21 derived from Reclamation (2008), flows in Old and Middle Rivers are consistently greater than the  
22  $-2,000 \pm 500 \text{ cfs}$  threshold for entrainment (i.e., more upstream flow) (National Marine Fisheries  
23 Service 2009a). Assuming that, in the normal (natural) flow patterns in the Delta, juvenile and  
24 smolting Chinook salmon and steelhead will use flow as a cue in their movements and will orient to  
25 the ambient flow conditions prevailing in the Delta waterways, then upstream flows will direct fish  
26 toward the pumps during current operations (National Marine Fisheries Service 2009a), when the  
27 Old and Middle Rivers flows are more negative than  $-2,000 \text{ cfs}$ .

28 During wet, above-normal, and critically dry water-year types, the greatest level of negative net  
29 flows in Old and Middle Rivers are seen during the months of December, January, and July (National  
30 Marine Fisheries Service 2009a). The months of December and January coincide with the occurrence  
31 of juvenile winter-run and yearling spring-run Chinook salmon into the north Delta from the  
32 Sacramento River (National Marine Fisheries Service 2009a). NMFS (2009a) believes that these  
33 elevated levels of net negative flow present a risk to emigrating fish that have entered the central  
34 Delta through Georgiana Slough or, when the DCC gates are open, through the Mokelumne River  
35 system. In below-normal and dry water-year types, the Old and Middle River flows have high levels  
36 of net negative flow from December through March and again in June and July; this overlaps with a  
37 significant proportion of the salmonid emigration period through the Delta in the spring,  
38 particularly for winter-run Chinook salmon and Central Valley steelhead (National Marine Fisheries  
39 Service 2009a).

#### 40 ***Old and Middle River Flow Targets***

41 To protect pre-spawning adult delta smelt from entrainment during the initial high flows of the wet  
42 season (first flush), and to provide advantageous hydrodynamic conditions early in the migration  
43 period, the 2008 USFWS BiOp (U.S. Fish and Wildlife Service 2008) stipulates an average daily OMR  
44 flow of no more negative than  $-2,000 \text{ cfs}$  for a total duration of 14 days, with a 5-day running

1 average of no more negative than -2,500 cfs (within 25%) (i.e., Action 1). The cue for when this  
2 action is triggered depends on the date, as summarized below.

- 3 • **December 1 to December 20** – Based on an examination of turbidity data from Prisoner’s Point,  
4 Holland Cut, and Victoria Canal; salvage data from the SWP and CVP; and other parameters  
5 important to the protection of delta smelt including, but not limited to, preceding conditions of  
6 X2, Fall Midwater Trawl, and river flows, the Smelt Working Group (SWG) may recommend a  
7 start date to USFWS (U.S. Fish and Wildlife Service 2008).
- 8 • **After December 20** – The action will begin if the 3-day average turbidity at Prisoner’s Point,  
9 Holland Cut, and Victoria Canal exceeds 12 nephelometric turbidity units (NTUs). However, the  
10 SWG can recommend a delayed start or interruption based on other conditions, such as Delta  
11 inflow, that may affect vulnerability to entrainment (U.S. Fish and Wildlife Service 2008).

12 Subsequent to implementation of Action 1 (above), Action 2 is then implemented using an adaptive  
13 process to tailor protection to changing environmental conditions. As in Action 1, the intent of  
14 Action 2 is to protect pre-spawning adults from entrainment and, to the extent possible, from  
15 adverse hydrodynamic conditions (U.S. Fish and Wildlife Service 2008). Action 2 prescribes that the  
16 range of net daily OMR flows will be no more negative than -1,250 cfs to -5,000 cfs. Depending on  
17 extant conditions (and the general guidelines below), specific OMR flows within this range are  
18 recommended by the SWG from the onset of Action 2 through its termination. The OMR flow  
19 requirements do not apply whenever a three-day flow average is greater than or equal to 90,000 cfs  
20 in the Sacramento River at Rio Vista and 10,000 cfs in the San Joaquin River at Vernalis (U.S. Fish  
21 and Wildlife Service 2008). Once such flows have abated, the OMR flow requirements of Action 2  
22 take effect (U.S. Fish and Wildlife Service 2008).

23 The window for triggering Action 1 and Action 2 concludes when either of the following conditions  
24 is met: (1) water temperature reaches 53.6°F (12°C) based on a three-station daily mean at  
25 Mossdale, Antioch, and Rio Vista; or (2) delta smelt spawning begins (presence of spent females in  
26 the Spring Kodiak Trawl spawning survey or observed in salvage at Banks or Jones pumping plant)  
27 (U.S. Fish and Wildlife Service 2008).

28 To minimize the number of larval delta smelt entrained at the facilities, once spawning is believed to  
29 have initiated (as determined by the two offramp conditions under Actions 1 and 2, above), net daily  
30 OMR flow will be no more negative than -1,250 cfs to -5,000 cfs based on a 14-day running average,  
31 with a simultaneous 5-day running average within 25% of the applicable requirement for OMR (U.S.  
32 Fish and Wildlife Service 2008). Offramp conditions for Action 3 include: (1) June 30; or (2) when  
33 water temperature reaches a daily average of 77°F (25°C) for three consecutive days at CCF (U.S.  
34 Fish and Wildlife Service 2008).

35 The 2009 NMFS BiOp also prescribes actions related to Old and Middle River flows and exports from  
36 January 1 through June 15 to protect anadromous salmonids, which limits negative flows to -2,500  
37 cfs to -5,000 cfs in Old and Middle Rivers, depending on the presence of salmonids (National Marine  
38 Fisheries Service 2009a). Reverse flows are managed to reduce flows toward the pumps during  
39 periods of increased salmonid presence. The negative flow objective within the range will be  
40 determined based on a decision process, as described in National Marine Fisheries Service (2012a).  
41 On-going litigation modified implementation of these actions in 2012. In 2012, OMR flow conditions  
42 were set at -2,500 cfs for April 8–14, 2012 and -3,500 cfs April 15–30, 2012 (National Marine  
43 Fisheries Service 2012a).

### 11.1.5.3 Migration Barriers

Migration barriers or impediments may be caused by physical structures, inadequate attraction flows, adverse water quality conditions, delayed flooding of marshlands, or other factors. Barriers or impediments to movement of migrating fish species in the Delta may affect their physical condition (e.g., mechanical injury), physiological condition (e.g., spawning readiness and smolting), and/or survival (e.g., predation risk). In addition, barriers or impediments can result in straying of anadromous fish species (i.e., returning to non-natal streams).

Migration barriers and impediments to fish species within the Delta include the DCC, the Sacramento River Deep Water Ship Channel (SRDWSC), and the Stockton Deep Water Ship Channel (SDWSC). Additional passage barriers include structures located in Delta waterways, discussed below.

#### Delta Cross Channel Operations

The DCC diverts Sacramento River water into Snodgrass Slough and the Mokelumne River (when the DCC gates are open), where the water then flows through natural channels within the Central Delta until it reaches the SWP and CVP pumping plants, about 50 miles away (CALFED Bay-Delta Program 2001). A detailed discussion of DCC operations is provided in Chapter 5, *Water Supply*. As noted there, the DCC operation (open) improves water quality in the Central Delta by improving circulation patterns of good quality water from the Sacramento River and reducing salt water intrusion in the western Delta). The enhanced stability of the freshwater pool in the Delta has enabled nonnative species, such as centrarchids and catfish, as well as invasive plants, such as Brazilian waterweed *Egeria* and water hyacinth, to thrive (Brown and Michniuk 2007; National Marine Fisheries Service 2009a; Hestir 2010).

While the DCC improves water quality, the modification in water flows creates false attraction (attraction during adult immigration to non-natal rivers) to fish species such as Chinook salmon drawing these species into the lower San Joaquin River (National Marine Fisheries Service 2009a). Adult Chinook salmon that enter this area of the Delta are delayed in their upstream migration while they search for the distinctive olfactory (scent) migration cues of the Sacramento River in the lower San Joaquin River (National Marine Fisheries Service 2009a).

Fish such as juvenile salmonids that are in the central Delta generally have lower survival rates than fish that continue migrating downstream in the Sacramento River toward the west Delta. Recent studies appear to support the conclusion that closing the DCC gates will improve the survival of juvenile salmonids originating from the Sacramento River and migrating through the Delta (Bureau of Reclamation 2008a). Specifically, a recent particle tracking study (Kimmerer and Nobriga 2008) shows that DCC gate closure results in substantial increases in the proportion of Sacramento River water flowing into Georgiana Slough, Threemile Slough, and at the confluence of the Sacramento and San Joaquin Rivers, resulting in an overall similar proportion of flow diverted to the central Delta. This suggests that DCC gate closure may have less influence on the potential for central Delta fish mortality than previously thought (Bureau of Reclamation 2008a).

Studies for 2006–2007 by Perry and Skalski (2008 as cited in National Marine Fisheries Service 2009a) indicate that by closing the DCC gates when fish are present, total through-Delta survival of marked fish to Chipps Island increases by nearly 50% for fish moving downstream in the Sacramento River system. For 2007–2008 Perry and Skalski (2009) also found that fish survival in the interior Delta was lower than in the Sacramento River. However, closure of the DCC gates and

1 the reduced flow did not result in a proportional reduction of salmon entry into the interior Delta.  
2 They found that a 30% reduction in DCC flow only resulted in a 15% entry reduction because more  
3 fish entered through the natural Georgiana Slough channel. The chance of fish entry into Georgiana  
4 Slough actually increased with the DCC gates closed, during that evaluation.

5 Perry et al. (2012) address migration routes and survival through the system in 2009-2010, which  
6 experienced higher flows than previous years in the study (see previous paragraph). They report  
7 lower survival rates for interior Delta migration compared to the Sacramento River migration route.  
8 The DCC gates were closed for all but one of their studied release groups.

9 The 2009 NMFS BiOp prescribes additional monitoring and alerts to trigger changes in DCC  
10 operations in order to reduce loss of emigrating salmonids and green sturgeon (National Marine  
11 Fisheries Service 2009a). Monitoring of salmonids and green sturgeon will be conducted in the Delta  
12 and upstream areas. Information collected from the monitoring programs will be used to make real-  
13 time decisions regarding DCC gate operation and export pumping (National Marine Fisheries Service  
14 2009a).

15 The 2009 NMFS BiOp also prescribes modifications to DCC gate operations to reduce direct and  
16 indirect mortality of emigrating juvenile salmonids and green sturgeon (National Marine Fisheries  
17 Service 2009a). Between November 1 and June 15, DCC gate operations will be modified to reduce  
18 loss of emigrating salmonids and green sturgeon. The operating criteria provide for longer periods  
19 of gate closures during the emigration season to reduce direct and indirect mortality of yearling  
20 anadromous salmonids (National Marine Fisheries Service 2009a). From December 1 to January 31,  
21 the gates will remain closed, except as operations are allowed using the implementation  
22 procedures/modified Salmon Decision Tree, as described in NMFS (2009a).

### 23 **Stockton Deep Water Ship Channel**

24 The SDWSC has been identified as an impaired waterway because of low DO concentrations during  
25 late summer and early fall. The combination of low flows, high loads of oxygen-demanding  
26 substances (e.g., wastewater effluent), and channel geometry contribute to low DO levels (National  
27 Marine Fisheries Service 2009a). The State Water Resources Control Board (State Water Board) has  
28 established DO objectives of 6.0 milligrams per liter (mg/L) in the San Joaquin River between  
29 Turner Cut and Stockton from September 1 through November 30, and 5 mg/L during the  
30 remainder of the year, for the protection of aquatic life (Central Valley Regional Water Quality  
31 Control Board 2007). A detailed description of the SDWSC and low DO concentrations is provided in  
32 Chapter 6, *Surface Water*. The low DO area in the ship channel can act as a barrier, impediment, or  
33 source of mortality to upstream and downstream migrating San Joaquin River anadromous  
34 salmonids and other fish species.

35 Low DO levels are frequently observed in the portion of the SDWSC extending from Channel Point,  
36 downstream to Turner and Columbia Cuts (National Marine Fisheries Service 2009a). Over a 5-year  
37 period, starting in August 2000, a DO meter has recorded channel DO levels at Rough and Ready  
38 Island (Dock 20 of the West Complex). During this time period, there were 297 days in which the DO  
39 was below 5 mg/L in the San Joaquin River between Channel Point and Turner and Columbia Cuts  
40 during the September-through-May migratory period for salmonids (National Marine Fisheries  
41 Service 2009a). DWR's California Data Exchange Center data indicate that DO depressions occur  
42 during all migratory months, with substantial events occurring from November through March  
43 when Central Valley steelhead adults and smolts would be using this portion of the San Joaquin  
44 River as a migratory corridor (National Marine Fisheries Service 2009a).

1 Potential factors that contribute to these DO depressions are reduced river flows through the ship  
2 channel, released ammonia from the City of Stockton Regional Wastewater Control Facility,  
3 upstream contributions of organic materials (e.g., algal loads, nutrients, and agricultural discharges)  
4 and the increased volume of water in the dredged ship channel (National Marine Fisheries Service  
5 2009a). During the winter and early spring emigration period, increased ammonia concentrations in  
6 the discharges from the City of Stockton Regional Wastewater Control Facility lower the DO in the  
7 adjacent SDWSC near the West Complex (National Marine Fisheries Service 2009a). In addition to  
8 the negative effects of the lowered DO on salmonid physiology, ammonia is in itself toxic to  
9 salmonids at low concentrations. Likewise, adult fish migrating upstream will encounter lowered DO  
10 in the SDWSC as they move upstream in fall and early winter due to low flows and excessive algal  
11 and nutrient loads coming downstream from the upper San Joaquin River watershed (National  
12 Marine Fisheries Service 2009a). Hallock et al. (1970) reported that levels of DO below 5 mg/L delay  
13 or block adult fall-run Chinook salmon upstream migration.

14 To address low DO levels in the SDWSC, DWR initiated the SDWSC Aeration Facility Program to  
15 assess DO aeration techniques. The program comprises a full-scale aeration system (California  
16 Department of Water Resources 2009a). The system has been sized to deliver approximately 10,000  
17 pounds of oxygen per day into the SDWSC (California Department of Water Resources 2009a). The  
18 aeration system is anticipated to only be operated when SDWSC DO levels are below the Basin Plan  
19 (Central Valley Regional Water Quality Control Board 2007) DO water quality objectives  
20 (approximately 100 days per year). The program includes an ongoing assessment of DO levels in the  
21 SDWSC and vicinity (California Department of Water Resources 2009a).

#### 22 **Sacramento River Deep Water Ship Channel**

23 A set of locks at the end of the SRDWSC, at the connection with the Sacramento River blocks the  
24 migration of all fish from the channel back to the Sacramento River (Bureau of Reclamation 2008a).

#### 25 **South Delta Temporary Barriers Project**

26 The South Delta TBP consists of installation and removal of temporary rock barriers across several  
27 South Delta channels at the following locations: (1) Middle River near Victoria Canal; (2) Old River  
28 near Tracy; (3) Grant Line Canal near Tracy Boulevard Bridge; and (4) the head of Old River at the  
29 confluence of Old River and the San Joaquin River.

30 In various combinations, these barriers are intended to improve water levels and San Joaquin River  
31 salmon migration in the south Delta (U.S. Fish and Wildlife Service 2008). The barriers on Middle  
32 River, Old River near Tracy, and Grant Line Canal are flow control facilities designed to improve  
33 water levels for agricultural diversions and are in place during the growing season. During spring,  
34 the barrier at the head of Old River is intended to reduce the number of outmigrating salmon smolts  
35 entering Old River. During fall, this barrier is intended to improve flow and increase DO  
36 concentrations in the San Joaquin River near Stockton during the immigration period of adult fall-  
37 run Chinook salmon. As required under the 2008 USFWS BiOp, DWR will install the head of Old  
38 River barrier in the spring only if USFWS determines that delta smelt entrainment is not a concern  
39 (U.S. Fish and Wildlife Service 2008). The installation and operation of the South Delta TBP will  
40 continue until permanent gates are constructed (i.e., approximately 2012) (U.S. Fish and Wildlife  
41 Service 2008). As the permanent gates are being constructed, temporary barrier operations will  
42 continue as planned and permitted (U.S. Fish and Wildlife Service 2008).

1 NMFS (2009a) determined that the South Delta TBP would likely result in the following effects.

- 2 • Changes to flow patterns in the south Delta, increasing the potential for migration delays in  
3 conjunction with the barriers placement.
- 4 • Hydraulic conditions that will impede free passage of fish through the channels of the south  
5 Delta.
- 6 • Entrainment of a proportion of the fish that remain in the mainstem of the San Joaquin River  
7 into the channels leading southward under the influence of the SWP and CVP water diversion  
8 pumps.
- 9 • Increased risk of predation on juvenile salmonids and green sturgeon.
- 10 • Impacts on the functioning of the south Delta waterways as critical habitat for steelhead and  
11 green sturgeon by negatively impacting the value of the channels for migration and rearing  
12 (National Marine Fisheries Service 2009a).

### 13 South Delta Improvements Program

14 The objectives of the South Delta Improvements Program (SDIP) are to: (1) reduce the movement of  
15 outmigrating salmon from the San Joaquin River into Old River; (2) maintain adequate water levels  
16 and circulation in south Delta channels; and (3) increase water delivery and reliability to the SWP  
17 and CVP by increasing the diversion limit at CCF to 8,500 cfs (Bureau of Reclamation 2008a). A two-  
18 staged implementation approach is being followed for the SDIP.

- 19 • Stage 1 involves the construction and operation of gates at four locations in the South Delta  
20 channels and will address the first two objectives of the program. Proposed operation of the  
21 SDIP gates is described in detail in Chapter 5, *Water Supply*.
- 22 • Stage 2, if implemented, would address the objective of increasing the water delivery reliability  
23 of the SWP and CVP by increasing the diversion limit at CCF; however, this decision has been  
24 deferred indefinitely (Bureau of Reclamation 2008a; U.S. Fish and Wildlife Service 2008).

25 Stage 1 of the SDIP involves the placement of four permanent gates in the channels of the South  
26 Delta already affected by the temporary rock barriers installed under the South Delta TBP. NMFS  
27 expects that the operation of the permanent gates proposed for the SDIP will have many of the same  
28 effects as the South Delta TBP in regards to changes in the regional hydrodynamics and the increase  
29 in predation levels associated with the physical structures and near-field flow aspects of the  
30 barriers, as described below (National Marine Fisheries Service 2009a).

31 Stage 1 of the SDIP four gates TBP will require that any fish entering the South Delta will have to  
32 negotiate at least two gates to move through the system (National Marine Fisheries Service 2009a).  
33 The physical structures of the gates will create a point where predation pressure is increased and  
34 which migrating fish must negotiate to complete their downstream journey if they enter the South  
35 Delta channels (National Marine Fisheries Service 2009a). The barriers will also create predator  
36 habitat within the channels of the south Delta. The environmental stressors created by the  
37 implementation of the SDIP will add to the existing stressors present in the San Joaquin River Basin  
38 (National Marine Fisheries Service 2009a). NMFS (2009a) required that DWR halt implementation  
39 of the SDIP, and indicated that consultation for the SDIP cannot be reinitiated until after three years  
40 of fish predation studies at the temporary barrier are completed.

1 For further description of the potential effects on anadromous salmonids and green sturgeon from  
2 implementation of the SDIP, refer to NMFS (2009a). The final year of monitoring was to be  
3 completed in 2012, although the program is currently deterred indefinitely as a result of the POD in  
4 the Delta). Subsequent evaluation will determine the extent to which the program would be  
5 implemented.

### 6 **Head of Old River Fish Control Gate**

7 The original purpose of the Head of Old River Fish Control Gate was to benefit fall/late fall-run  
8 Chinook salmon by reducing the movement of salmon into the south Delta channels via the Old  
9 River. However, its effectiveness in preventing the salmon moving into the south Delta channels has  
10 not been verified.

11 Spring operation (closing) of the Head of Old River Fish Control Gate is regulated at the discretion of  
12 the fish and wildlife agencies and dependent on San Joaquin River flows. The gate can close as early  
13 as April 1 and continue through June 15, within the goal of protecting outmigrating salmon and  
14 steelhead. When the spring operation is completed, the gate would be operated in the fall to improve  
15 flow in the San Joaquin River (September and continues through December 7), thus helping to avoid  
16 historically present low DO conditions in the lower San Joaquin River near Stockton (Bureau of  
17 Reclamation 2008a). During this period, partial operation of the gate (partial closure to restrict  
18 flows from the San Joaquin River into Old River to approximately 500 cfs) may also be warranted to  
19 protect water quality in the south Delta channels. Generally, water quality in the south Delta  
20 channels is acceptable through June (Bureau of Reclamation 2008a). As discussed above,  
21 implementation of the SDIP, including the Head of Old River Fish Control Gate, may further increase  
22 stressors (e.g., passage impediments, predation) to fishes in the San Joaquin River and south Delta  
23 (National Marine Fisheries Service 2009a). A National Marine Fisheries Service Biological Opinion  
24 (National Marine Fisheries Service 2012) on the South Delta Temporary Barriers Program addresses  
25 the Head of Old River. It concluded that their installation and operation would not likely jeopardize  
26 the continued existence of the covered species or adversely modify or destroy designated critical  
27 habitats. The installation and operation of a rock barrier, rather than a gate, at Old River is  
28 proceeding.

### 29 **Navigation and Flood Control**

30 Flood control and navigation-related activities that alter aquatic habitat in the Delta include levees  
31 and levee maintenance, and channel maintenance and dredging. A detailed discussion of levees,  
32 levee maintenance, and channel maintenance and dredging in the Plan Area is presented in  
33 Chapter 6, *Surface Water*. Levee construction and maintenance, and channel maintenance and  
34 dredging activities have resulted in a loss of access by fish to seasonally inundated floodplain  
35 habitat, loss of riparian habitat, channel form changes, and water quality changes in the Plan Area.

### 36 **Levees and Levee Maintenance**

37 The development of the water conveyance system in the Delta has resulted in construction of more  
38 than 1,100 miles of armored levees to increase channel flood capacity elevations and flow capacity  
39 of the channels (Mount 1995). Creation of levees and the deep water shipping channels has reduced  
40 the natural tendency of the San Joaquin and Sacramento Rivers to create floodplains along their  
41 banks with seasonal inundations (Bureau of Reclamation 2008a). These annual inundations  
42 provided habitat for rearing and foraging juvenile native fish that evolved with this flooding process  
43 (National Marine Fisheries Service 2009a). The construction of levees disrupts the natural

1 hydrologic processes, resulting in a multitude of habitat-related effects, including isolation of the  
2 natural floodplain behind the levee from the active channel and its fluctuating hydrology (National  
3 Marine Fisheries Service 2009a). Alterations in channel form and fluvial geomorphology reportedly  
4 have led to loss of shallow water habitats, channel deepening, reduced floodplain areas, aquatic  
5 habitat degradation, and alteration of lotic (in-water biological, chemical and physical interactions)  
6 conditions in the Delta and the North San Francisco Bay (North Bay) (CALFED Bay-Delta Program  
7 1997), in addition to parts of upstream rivers (National Marine Fisheries Service 2009a).

8 Many of these levees use riprap to armor the bank from erosive forces. The effects of channelization  
9 and riprapping include the alteration of river hydraulics and cover along the bank as a result of  
10 changes in bank configuration and structural features (National Marine Fisheries Service 2009a).  
11 These changes affect the quantity and quality of nearshore habitat for juvenile fishes and have been  
12 well studied (National Marine Fisheries Service 2009a). Simple slopes protected with rock  
13 revetment generally create nearshore hydraulic conditions characterized by greater depths and  
14 faster, more homogeneous water velocities than occur along natural banks. Higher water velocities  
15 typically inhibit deposition and retention of sediment and woody debris. These changes generally  
16 reduce the range of habitat conditions typically found along natural shorelines, especially by  
17 eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from  
18 fast currents, deep water, and predators (National Marine Fisheries Service 2009a). In addition, the  
19 armoring and revetment of stream banks tends to narrow rivers, reducing the amount of habitat per  
20 unit channel length (Sweeney et al. 2004).

21 In addition to direct effects of levees on aquatic habitat and fishes, riparian vegetation is eliminated  
22 in the riprapped portion of leveed banks, eliminating overhanging vegetation and future woody  
23 debris sources (Bureau of Reclamation 2008a). Large woody debris provides valuable habitat to fish  
24 such as salmonids (Bureau of Reclamation 2008a). Woody debris also has been removed from some  
25 rivers because it is perceived as a hazard to swimmers and boaters and impedes navigation (Bureau  
26 of Reclamation 2008a). The cumulative habitat loss from lack of woody debris recruitment, woody  
27 debris removal, and riprapping could be a factor in the decline of some Central Valley salmon  
28 populations (Bureau of Reclamation 2008a).

29 Most levees in the Delta were constructed from materials dredged from low-lying edges of islands,  
30 or adjacent channels. Emergency levee repairs have required importation of large amounts of riprap  
31 and other materials. Due to current concerns about the impacts of dredging on listed fish species  
32 and water quality, dredging for levee maintenance has slowed (Delta Protection Agency 2007).  
33 Active maintenance actions of reclamation districts have precluded the establishment of ecologically  
34 important riparian vegetation, introduction of valuable instream woody materials from these  
35 riparian corridors, and the productive intertidal mudflats characteristic of the undisturbed Delta  
36 habitat (National Marine Fisheries Service 2009). Other consequences of reduced riparian habitats  
37 include the loss of shaded riverine aquatic habitat, channel complexity, and food supplies (CALFED  
38 Bay-Delta Program 1997).

### 39 **Channel Maintenance and Dredging**

40 In support of commercial shipping in the Delta, dredging of the SDWSC and the SRDWSC will  
41 continue into the future (National Marine Fisheries Service 2009a). Dredging activities can result in  
42 physical, biological, and chemical changes to aquatic habitats in the Delta. In addition to the initial  
43 physically disruptive effects, the composition and abundance of the benthic community can become  
44 altered after dredging (U.S. Army Corps of Engineers 2004). Dredging also can result in a variety of

1 water quality effects, such as increased turbidity, decreased DO, and resuspension of contaminated  
2 sediments (U.S. Army Corps of Engineers 2004). For example, DO concentrations in the water  
3 column can be substantially reduced during dredging if the suspended dredged material contains  
4 high concentrations of oxygen-demanding substances (e.g., hydrogen sulfide) (U.S. Army Corps of  
5 Engineers 2004). These effects have the potential to alter fish movement, distribution and survival,  
6 prey resources, and predation. Refer to U.S. Army Corps of Engineers (2004) for a detailed  
7 discussion of potential biological effects of dredging activities.

## 8 **Water Quality, Contaminants, and Toxicity**

9 Contaminants are organic and inorganic chemicals and biological pathogens that can cause adverse  
10 physiological response in humans, plants, fish, or wildlife (California Department of Fish and Game  
11 2008b). A variety of contaminants entering Delta waterways are hypothesized to have direct effects  
12 on fish species and food web processes that adversely affect food abundance and availability. A  
13 detailed description of contaminants affecting Delta waterways, their potential effects on the  
14 physical environment, and the regulatory environment governing water quality is provided in  
15 Chapter 8, *Water Quality*.

## 16 **Nutrient Input and Ammonia**

17 In general, increased input of nutrients from agricultural runoff, wastewater treatment, and other  
18 sources can be an ecosystem stressor, and is often associated with low DO levels and other water  
19 quality stressors. In many aquatic systems, increased nutrient inputs result in algae blooms, which  
20 in turn result in low DO. However, algal blooms and anoxia are not common in the Delta system, and  
21 the change in nutrient cycling has been associated with a shifting in phytoplankton species  
22 assemblages, rather than increased primary productivity (Glibert 2011 and 2010).

23 The primary source of total ammonia in the Delta has historically been effluent discharged from  
24 WWTPs, and the primary contributing treatment facility is the Sacramento Regional WWTP (Jassby  
25 2008). The facility also has been the largest source of total ammonia discharge to the Delta, making  
26 up 90% of the Sacramento River ammonia load (Jassby 2008). However, ammonia discharges from  
27 the Sacramento Regional facility have been decreasing, and will continue to decrease in compliance  
28 with regulatory requirements. The Stockton Regional Wastewater Control Facility historically had  
29 also been an important source of the ammonia load to the Delta via the San Joaquin River. This is no  
30 longer the case, as the Stockton facility has upgraded its treatment systems in recent years to  
31 include technology to remove ammonia and ammonium from effluent before discharge to the river  
32 (City of Stockton 2011).

33 Several researchers have linked inhibition of diatom productivity and increases in cyanobacteria  
34 and flagellates with increased ammonia in the Delta system (Baxter et al. 2010; Glibert 2010 and  
35 2011). Glibert (2011) also cites the changes in nitrogen to phosphorous ratios with changes in  
36 species makeup.

37 Some studies have indicated ecosystem effects of ammonium at low concentrations below the AWQC  
38 levels. A recent study indicated that biota can be affected at concentrations as low as 0.38 mg/L of  
39 total ammonia nitrogen, based on a study of Delta copepods by Teh et al. (2011).

40 However, discharges of ammonium to the Delta from WWTPs have been, and continue to be,  
41 significantly reduced. The Sacramento Regional WWTP upgrades are expected to reduce  
42 ammonia/um loading into the Sacramento River. While this is not a result of BDCP, it is a related

1 regional action that has the potential to affect the outcome of BDCP effects on covered fish species.  
2 In this case, reduced ammonia/um loading from Sacramento Regional WWTP would further reduce  
3 the potential for the BDCP to result in increased transport or accumulation in the Plan Area.

4 A detailed discussion of ammonia sources and the distribution of ammonia in the Delta is provided  
5 in Chapter 8, *Water Quality*.

## 6 **Blue-Green Algae**

7 Cyanobacteria (i.e., “blue-green algae”) are common in estuarine waters and under certain  
8 conditions; however, large blooms of the toxic cyanobacterium have occurred in the central and  
9 western regions of the Delta since 1999 (Lehman et al. 2005), primarily during the summer and fall  
10 months (Lehman et al. 2005). The increase in cyanobacteria is part of the shift in the Delta food  
11 chain from diatom-based to less valuable food sources of smaller, cyanobacteria, flagellates and  
12 invasive copepods (Glibert 2010 and 2011; Baxter et al 2010). The large blooms that occur  
13 throughout the Delta are suspected of adversely affecting food web dynamics via reduced feeding  
14 and reproduction in aquatic invertebrates and may be a contributing factor to the POD in the Delta  
15 (Baxter et al. 2008). However, Lehman et al. (2005) and Lehman et al. (2008a) reported that the  
16 greatest threat of blue-green algae may be its negative impact on the quantity and quality of  
17 phytoplankton biomass (i.e., the basis of the Delta food web) through its inhibition of light  
18 transmission through the water column, rather than its direct or indirect toxic effects on aquatic  
19 organisms (Lehman et al. 2005). The presence of microcystins in the tissues of lower food web  
20 organisms (e.g., mesozooplankton, amphipods, worms, jellyfish, and clams) indicates that blooms of  
21 blue-green algae play a potentially substantial ecological role in Delta food web dynamics (Lehman  
22 et al. 2008a). Furthermore, microcystins may bioaccumulate, and may threatening the higher  
23 trophic levels of the food web (Lehman et al. 2005; Lehman et al. 2010).

24 Preliminary evidence indicates that the toxins produced by local blue-green algae blooms are not  
25 toxic to fish at current concentrations. However, blue-green algae could out-compete diatoms for  
26 light and nutrients, which are a rich food source for zooplankton in the Delta (Mueller-Solger et al.  
27 2002). Water Temperature

28 Elevated water temperatures are a stressor on many aquatic species, which may be caused by lower  
29 flows, increased water surface area, warmwater inflow, lack of riparian shade, or other factors.  
30 Elevated water temperatures can generally affect fish and aquatic species by increasing respiration  
31 and metabolism, increasing growth rates, reducing resistance to diseases, decreasing reproductive  
32 fitness and success, reducing resistance to predation, and increasing mortality rates. Water  
33 temperature is closely correlated to air temperature in many cases, but may be heavily influenced by  
34 the related hydrologic conditions and/or lack of riparian shade. Maintenance of stream  
35 temperatures upstream of the Delta is important not only in terms of individual species’ tolerances,  
36 but also because temperature drives metabolic and primary production rates and can influence  
37 mobilization rates of toxics and nutrients (e.g., development of toxic algal blooms from  
38 cyanobacteria) (California Department of Fish and Game 2008b). While riparian habitat may help to  
39 lower water temperatures in the tributaries to the Delta, water temperatures in the Delta and in  
40 Suisun Marsh channels are driven primarily by environmental factors (e.g., air temperature).

41 Delta hydrodynamic simulations reveal that tidal action and other factors may cause substantial  
42 mixing of water with variable salinity and temperature among regions of the Delta (Monsen et al.  
43 2007). Although cooler water temperatures are usually the norm until after the spring runoff has

1 ended, some portions of the Delta (i.e., south Delta and central Delta) can reach approximately 70°F  
2 by February during a dry year (National Marine Fisheries Service 2009a).

3 Preliminary DWR research in Suisun Marsh suggests potential for mature tidal marsh landscapes  
4 that flood on a biweekly time scale to contribute to significant temperature variation in the tidal  
5 sloughs that drain these marshes (Department of Water Resources 2009b). During late spring and  
6 summer, the water that drains from tidal marshes back into the surrounding sloughs overnight can  
7 be cooler than it was during the warm afternoon, due to the water sitting in very shallow pools on  
8 the marsh plain and being cooled by evaporation during nighttime (Department of Water Resources  
9 2009b). However, this research has not been finalized.

## 10 **Dissolved Oxygen**

11 DO is the form of oxygen upon which most aquatic life depends (California Department of Fish and  
12 Game 2008b). DO concentrations are influenced by processes such as photosynthesis, atmospheric  
13 diffusion, biological oxygen demand, and aeration from wind/wave action.

14 Behavior of fish and aquatic organisms in response to DO levels can lead to short-term migrations  
15 (influenced by daily light cycles) or seasonal use patterns since DO levels are strongly affected by  
16 temperature (Hackney et al. 1976). When DO levels fall below the range of 5 to 9 mg/L, fish  
17 behaviors such as feeding, migration, and reproduction can be adversely affected (California  
18 Department of Fish and Game 2008b). DO levels approaching 2 mg/L yield hypoxic (reduced oxygen  
19 concentration) conditions, which serve as a delay to fish migration and can eradicate food web  
20 organisms (California Department of Fish and Game 2008b). A decrease in food web organisms  
21 decreases growth and fitness which lessens survival. Delays in migration affects spawning if fish  
22 cannot access appropriate spawning areas to deposit eggs. A decrease in fitness occurs either from  
23 females retaining eggs or minimal egg survival due to poor spawning habitat quality. Low DO levels  
24 can cause physiological stress and mortality to fish and other aquatic organisms, can delay both  
25 upstream and downstream migration of Chinook salmon, and may affect steelhead and white  
26 sturgeon similarly (National Marine Fisheries Service 2009a). Studies also have shown that hypoxia  
27 can cause endocrine (hormone) disruption in adult fish (Wu et al. 2003; Thomas et al. 2007).  
28 Endocrine disruption can potentially include alteration to reproduction, development, and other  
29 hormonally mediated processes.

30 A detailed discussion of DO in the SDWSC and other areas of the Delta is provided in Chapter 8,  
31 *Water Quality*.

## 32 **Sediment and Turbidity**

33 Sediment contamination can impact the ecological condition of the Delta. Numerous bottom-  
34 dwelling fish species, such as sturgeon and common carp, forage on invertebrates and detritus  
35 associated with sediments. These fish may be exposed to contaminants through direct ingestion of  
36 toxic materials in the sediments or indirectly by ingesting sediment-dwelling organisms that have  
37 accumulated toxic materials in their tissues (i.e., bioaccumulation). A detailed discussion of  
38 sediment accumulation of toxic compounds and turbidity is provided in Chapter 8, *Water Quality*.

39 Turbidity levels affect fish in different ways. Higher turbidity may be beneficial to delta smelt, and to  
40 other prey fish that use it to avoid predation. Turbidity also has the potential to negatively affect  
41 some fish species such as salmonids by temporarily disrupting normal behaviors that are essential  
42 to growth and survival such as feeding, sheltering, and migrating. For example, behavioral avoidance

1 of turbid waters may be one of the most important effects of suspended sediments on salmonids  
2 (Birtwell et al. 1984; DeVore et al. 1980; Scannell 1988). Disruption of feeding behaviors increases  
3 the likelihood that individual fish would face increased competition for food and space, and  
4 experience reduced growth rates, or possibly weight loss. Elevated turbidity levels also may affect  
5 the sheltering abilities of some juvenile fishes and may increase their likelihood of survival by  
6 decreasing their susceptibility to predation. However, turbidity also has been reported to reduce  
7 predation risk to fish species such as migrating Chinook salmon in other estuaries (e.g., the Fraser  
8 River) (Nobriga 2008).

### 9 **Mercury and Methylmercury**

10 The chemistry of mercury in the environment is complex. Elemental mercury and mercury in the  
11 form of inorganic compounds have relatively low water solubility and tend to accumulate in soils  
12 and sediments. When mercury forms an organic complex called monomethylmercury (commonly  
13 referred to as methylmercury), it becomes more water soluble and the toxicity and bioavailability  
14 are greatly enhanced, making it a primary concern for ecosystem effects. Some habitats (e.g., high  
15 tidal marsh, seasonal wetlands, and floodplains) more readily facilitate the methylation of mercury,  
16 resulting in greater exposure to wildlife, whereas perennial aquatic habitats and low tidal areas  
17 have relatively lower methylation potential (Alpers et al. 2008; Ackerman and Eagles-Smith 2010;  
18 Wood et al. 2010).

19 The toxicity of methylmercury is amplified as it biomagnifies through the foodweb. Because  
20 methylmercury increases in concentration with each step up the food chain, the species at greatest  
21 risk to exposure are top predators including fish species such as bass and sturgeon (California  
22 Department of Fish and Game 2008b). Because of the widespread presence of toxic methylmercury  
23 in the Delta, much recent research has been completed on the cycling of methylmercury through the  
24 physical environment and biota of the area (Stephenson et al. 2007; Alpers et al. 2008; Ackerman  
25 and Eagles-Smith 2010; Wood et al. 2010).

26 A detailed discussion of mercury and methylmercury concentrations and distribution in the Delta is  
27 provided in Chapter 8, *Water Quality*.

### 28 **Selenium and Other Metals**

29 The main controllable sources of selenium in the Bay-Delta estuary are agricultural drainage  
30 (generated by irrigation of seleniferous soils in the western side of the San Joaquin basin) and  
31 discharges from North Bay refineries (in processing selenium-rich crude oil). Both the San Joaquin  
32 River and North Bay selenium loads have declined in the last 15 years in response to, first, a control  
33 program in the San Joaquin Grassland area, and, second, National Pollutant Discharge Elimination  
34 System (NPDES) permit requirements established for refineries in the late 1990s. The annual loads  
35 of selenium (mostly as selenate) entering the Bay-Delta estuary from the San Joaquin and  
36 Sacramento Rivers vary by water year (that is, by flow), but dissolved selenium loadings averaged  
37 2,380 kilograms per year (kg/year) from the San Joaquin and 1,630 kg/year from the Sacramento in  
38 the 1990–2007 period. The Sacramento River selenium concentration, however, is essentially at  
39 background levels (.06 +/- .02 µg/L), without evidence of significant controllable sources  
40 (U.S. Environmental Protection Agency 2011a).

41 The San Joaquin watershed, and specifically the Grassland section of the watershed, historically has  
42 been identified as a source of selenium to the Delta. However, mitigation measures have been put  
43 into place to manage selenium discharges to meet regulatory requirements. According to the

1 *Grassland Bypass Project Report 2006–2007*, selenium loads already had been reduced by 75% in  
2 2007 relative to 1996 levels (McGahan 2010:Chapter 2). Concentrations of selenium in Salt Slough  
3 reportedly met the monthly mean goal of 2 µg/L (U.S. Environmental Protection Agency 2011b).  
4 Selenium concentrations measured in the San Joaquin River were consistently below 5 µg/L  
5 (McGahan 2010:Chapter 2). As selenium discharge from the Grassland Bypass Project continues to  
6 decrease as the 5 µg/L goal is approached, concentrations in the San Joaquin River also can be  
7 expected to decrease.

8 Under the Grassland Bypass Project, selenium discharges to Mud Slough (in the San Joaquin  
9 watershed) must be substantially reduced by December 31, 2019. Further, the Central Valley  
10 Regional Water Quality Control Board (2010b) recently approved an amendment to the basin plan  
11 in light of this project. The amendment requires that agricultural drainage be halted after December  
12 31, 2019, unless water quality objectives are met in Mud Slough (north) and the San Joaquin River  
13 between Mud Slough (north) and the mouth of the Merced River. Also, if the State Water Resources  
14 Control Board (State Water Board) finds that timely and adequate mitigation is not being  
15 implemented, it can prohibit discharge any time before December 31, 2019. As a result, a substantial  
16 reduction in selenium inputs (unrelated to the BDCP) to the San Joaquin River by 2019 would be  
17 expected to result in lower selenium inputs to the Delta from the San Joaquin River.

18 Elevated selenium concentrations also have been identified in Suisun Bay. Although particulate  
19 concentrations of selenium (the most bioavailable) in this region are considered low, typically  
20 between 0.5 and 1.5 micrograms per gram (µg/g), the bivalve overbite clam (*Potamocorbula*  
21 *amurensis*) contains elevated levels of selenium that range from 5 to 20 µg/g (Stewart et al. 2004).  
22 Given the fact that *Potamocorbula* may occur in abundances of up to 50,000 per square meter, this  
23 area can be considered a sink for selenium because 95% of the biota in some areas are made up of  
24 this clam.

25 Selenium can occur in four oxidation stages as selenates (Se<sup>6+</sup>), selenites (Se<sup>4+</sup>), selenides (Se<sup>2-</sup>), and  
26 elemental selenium. The oxidized state, selenates (Se<sup>6+</sup>), is soluble and the predominant species in  
27 alkaline surface waters and oxidizing soil conditions. Selenates are readily reduced to selenites  
28 (Se<sup>4+</sup>) and selenides (Se<sup>2-</sup>), which are more bioavailable than selenate. Further reduction to  
29 elemental selenium can result in an insoluble precipitate, which is not bioavailable.

30 Although selenium is soluble in an oxidized state, the majority typically becomes reduced and  
31 partitions into the sediment/particulate phases in an aqueous system; these reduced  
32 sediment/particulate phases are the most bioavailable (Presser and Luoma 2010). Selenium in soils  
33 is taken up by plant roots and microbes and enters the food chain through uptake by lower  
34 organisms. A portion of the selenium also is recycled into sediments as biological detritus. Lemly  
35 and Smith (1987) indicate that up to 90% of the total selenium in an aquatic system may be in the  
36 upper few centimeters of sediment and overlying detritus (Lemly 1998).

37 Oxidized forms of selenium (selenates and selenites) may reduce further to precipitate as elemental  
38 selenium or complex with particulates. Selenate reduces to elemental selenium through  
39 dissimilatory reduction through reactions with bacteria. These reactions reduce selenium from  
40 surface waters, resulting in an increase in selenium concentrations in sediment over time. In  
41 wetlands in particular, the organic-rich stagnant waters create a chemically reducing environment  
42 in which dissolved selenate is able to convert to selenite or elemental selenium (Werner et al. 2008).  
43 The longer the residence time of surface waters, the higher the particulate concentration resulting in  
44 higher selenium concentrations in wetlands and shallows (Presser and Luoma 2006, 2010). Aquatic

1 systems in shallow, slow-moving water with low flushing rates are thought to accumulate selenium  
2 most efficiently (Presser and Luoma 2006; Lemly 1998). However, the ratio of selenium in  
3 particulates (which is more bioavailable) to selenium in the water column is a complex relationship  
4 that can vary across different hydrologic regimes and seasons (Presser and Luoma 2010).

5 Because bioaccumulation can be an important component of selenium toxicity, water column  
6 selenium concentrations are not reliable indicators of risk to biota (Presser and Luoma 2010).  
7 Selenium enters the food chain at a low trophic level and, under certain conditions, is magnified up  
8 the food chain. Lower trophic organisms can bioaccumulate hundreds of times the waterborne  
9 concentration of selenium, especially where a food chain is based on sessile filter feeders. However,  
10 research has demonstrated that bioaccumulation is less important when the food chain is based on  
11 plankton rather than on sessile filter feeders, because plankton excrete most of the selenium they  
12 consume (Stewart et al. 2004). This is an important factor that mitigates bioaccumulation in some of  
13 the covered fish species, and is more fully discussed in later sections of this chapter.

14 Accumulation and distribution of selenium and other metals is described in detail in Chapter 8,  
15 *Water Quality*.

### 16 **Agricultural Runoff**

17 Chapter 14, *Agricultural Resources*, describes agricultural practices within the Delta in detail. In  
18 general, agricultural practices in the Delta could potentially affect fish and aquatic resources as a  
19 result of pesticide and herbicide inputs into Delta waterways. Agricultural drainage into the Delta  
20 can contain elevated levels of nutrients, suspended solids, organic carbon, salinity, selenium, and  
21 boron in addition to pesticides (City of Stockton 2005). Chapter 8, *Water Quality*, contains a detailed  
22 description of potential agricultural runoff contaminants in the Delta.

### 23 **Herbicides and Pesticides**

24 Herbicides and pesticides are of concern because of their potential toxicity to fish and other aquatic  
25 species in the Delta. In recent years, the types of pesticides used in agriculture have changed. Use of  
26 organophosphate chemicals found in pesticides such as diazinon and chlorpyrifos has decreased in  
27 favor of pyrethroid pesticides. Detailed discussion of agricultural herbicide and pesticide use in the  
28 Delta is provided in Chapter 14, *Agricultural Resources*.

29 Preliminary data suggest that both organophosphate and pyrethroid pesticides may have  
30 contributed to the higher incidence of toxic events in 2007, a dry year (Baxter et al. 2008).  
31 Pyrethroids are a group of synthetic chemicals currently used as insecticides in urban and  
32 agricultural areas. More than 1,000 synthetic pyrethroids have been developed (Agency for Toxic  
33 Substances and Disease Registry 2003), but only 25 are registered for use in California (Spurlock  
34 and Lee 2008). Pyrethroids are powerful neurotoxins, have immunosuppressive effects, and can  
35 inhibit essential enzymes such as ATPases (Werner and Orem 2008). Pyrethroids can cause acute  
36 toxicity at concentrations as low as 1 µg/L in fish (Werner and Orem 2008), and at lower levels  
37 between 2 and 5 ng/L (0.002 and 0.005 µg/L) in invertebrates. When various types of pyrethroid  
38 compounds are present together in an aqueous environment, the toxicity can be additive with  
39 increased toxic effects (Weston and Lydy 2010).

40 In addition to agricultural sources, recent studies have shown that WWTPs and urban runoff are  
41 important sources of pyrethroids to the Delta system. Pyrethroids have been detected at  
42 concentrations lethal to a native amphipod (*Hyalella azteca*) in urban runoff and effluent from the

1 Stockton, Vacaville, and Sacramento WWTPs (Weston and Lydy 2010). In addition, receiving waters  
2 (San Joaquin River, American River, and Sacramento River) had detections of pyrethroids at levels  
3 toxic (or potentially toxic) to *Hyalella*, particularly after rain events during low river flow conditions.  
4 Concentrations were higher in Vacaville creeks receiving effluent. Weston and Lydy (2010) reported  
5 few to no detections or toxicity to amphipods in Sacramento River water downstream of the  
6 Sacramento WWTP.

7 Organophosphate pesticides (organophosphates) are human-made chemicals that are used for pest  
8 control in both urban and agricultural environments. Sources of diazinon and chlorpyrifos in the  
9 Delta are predominantly agricultural as the sale of these compounds for most nonagricultural uses  
10 has been banned in recent years. In the Delta, diazinon is applied to crops during the dormant  
11 season (December–February) and irrigation or growing season (March–November) fairly equally  
12 (52% and 48%, respectively), while the majority of chlorpyrifos (97%) is applied to Delta crops  
13 during irrigation season (McClure et al. 2006).

14 Diazinon and chlorpyrifos have slightly different chemical properties that affect the way they behave  
15 in aquatic environments. Diazinon is fairly soluble and mobile and will bind only weakly to soil and  
16 sediment. Chlorpyrifos is less soluble than diazinon and less mobile because of its tendency to bind  
17 much more strongly to soil and sediment. Consequently, diazinon enters the Delta dissolved in  
18 runoff, while chlorpyrifos enters the Delta adsorbed to soil particles (McClure et al. 2006). Unlike  
19 organochlorine pesticides, organophosphates do not tend to bioaccumulate, as they are readily  
20 metabolized by most organisms. For example, diazinon in fish will be approximately 96% removed  
21 in just 7 days (McClure et al. 2006).

## 22 **Endocrine Disrupting Compounds and Pharmaceutical and Personal Care Products**

23 In recent years, there has been heightened scientific awareness and public debate over potential  
24 impacts that may result from exposure to endocrine-disrupting compounds (EDC), some of which  
25 are found in pharmaceuticals and personal care products and enter waterways via water treatment  
26 facilities. EDCs may block, mimic, stimulate, and/or inhibit the production of natural hormones,  
27 disrupting the endocrine system's natural functions. A detailed discussion of the effects of EDCs and  
28 pharmaceutical and personal care products on water quality in the Delta is provided in Chapter 8,  
29 *Water Quality*.

30 Diethylstilbestrol (the drug DES) and certain pesticides (dioxin, polychlorinated biphenyls (PCBs),  
31 and DDT) are known endocrine disrupters in humans. In addition, plasticizers such as  
32 polybrominated diphenyl ethers (PBDEs) used as a fire retardant in furniture, televisions, and  
33 computers may bioaccumulate in fish and result in sublethal toxic effects. Studies conducted as part  
34 of the IEP's POD investigations showed some evidence of low frequency endocrine disruption in  
35 adult delta smelt males (Baxter et al. 2008).

36 Baxter et al. (2008) cite unpublished findings by Teh et al. reporting that 9 of 144 (6%) adult delta  
37 smelt males examined in 2005 had immature egg cells in their testes, an indication of low frequency  
38 endocrine disruption. Williamson and May (2002) examined 437 adult Chinook salmon from the  
39 Sacramento and San Joaquin Rivers and found that 16% of the 287 female specimens exhibited a  
40 Y-chromosome-specific marker, an indication that such fish were sex-reversed males (XY females).  
41 This study did not specifically correlate these incidences of possible sex-reversal to EDCs. In  
42 contrast, the Surface Water Ambient Monitoring Program exposed Rainbow Trout to 113 ambient  
43 water samples (de Vlaming et al. 2006), including 43 from Central Valley waterways that are  
44 tributary to the Delta, to determine exposure to estrogenic chemicals. The results of this study

1 indicated that six samples (5% of the total) may have contained EDCs. The report noted that all six  
2 of these samples were at or near the threshold for the procedure, or may have contained false  
3 positives, and the majority of the samples tested were below EDC threshold concentrations for the  
4 analytical procedure. This led the authors to conclude that natural and synthetic estrogens do not  
5 appear to be a substantial contaminant in northern California water bodies.

6 Because natural hormones occur in extremely low concentrations in fish, it is thought that extremely  
7 low concentrations of exogenous endocrine disruptors could affect fish. However, the potency of  
8 exogenous EDCs is typically of a lower magnitude than endogenous endocrines (Pait and Nelson  
9 2002). Endocrine disruption has been observed in fish exposed to wastewater effluents (Sumpter  
10 and Jobling 1995; Jobling et al. 1998; Chambers and Leiker 2006; Kidd et al. 2007). In Central Valley  
11 stream sampling, up to 38% of male fall-run Chinook salmon showed signs of endocrine disruption  
12 in the form of sex reversal (Williamson and May 2002). In 2005, a low level (6%) of adult delta smelt  
13 males showed evidence of endocrine disruption (Baxter et al. 2008). The identity and source of the  
14 EDCs causing these effects are not known.

## 15 **Nonnative Species**

16 The San Francisco Estuary has been described as the world's most invaded estuary, mostly due to  
17 the introduction of nonnative species via ballast water associated with the large volume of shipping  
18 from Asian ports (Cohen and Carlton 1998). As an active deepwater port with principal cargo  
19 destinations in Sacramento and Stockton, opportunities for ballast water introductions are high and  
20 frequent. Deliberate release of aquarium specimens, deliberate fisheries introductions, and bait  
21 bucket releases have also contributed to the number of nonnative species in the Bay-Delta  
22 (Kimmerer 2004). If local conditions are favorable, introduced species may establish successful  
23 reproducing populations; it appears that conditions in the Bay-Delta have historically been  
24 favorable for the establishment of a variety of species, particularly from south Asia. Introduced  
25 species that successfully establish often undergo a population boom, where the initial densities can  
26 be very high, followed by a bust that can reduce levels.

27 Extensive invasion of the Delta by nonnative species has been reported to have negatively affected  
28 ecosystem processes (California Department of Fish and Game 2008b). Changes in the Delta  
29 ecosystem caused by nonnative species have been reported to have reduced habitat suitability (e.g.,  
30 turbidity effect, changes in habitat structure), and changed predator-prey and competitive  
31 relationships between native and nonnative species.

- 32 • **Competition** – Competition is a natural mortality factor that can have an unnatural effect on  
33 native fish populations when the competitors are introduced species. Elevated losses of native  
34 species may occur due to competition for nest sites, shelter, food, and other resources.  
35 Competition as a stressor is directly related to introduction of exotic species, and to water  
36 management activities or land use actions that may alter habitat conditions in favor of  
37 introduced competitors.
- 38 • **Predation** – Predation by nonnative fish species in some areas of the Delta is a stressor causing  
39 reduced survival of migrating and resident fish. The types and densities of predators, as well as  
40 the transit times of migrating individuals, influence predation potential on native species.

## 1       **Nonnative Fish**

2       Many of the Delta's fish are introduced species (Dill and Cordone 1997), particularly in freshwater  
3       to low-salinity habitats (Moyle 2002; Brown and Michniuk 2007), and less so in the marine  
4       environment (CALFED Bay-Delta Program 2008). Some of the most common nonnative fish in the  
5       Delta are members of the family centrarchidae, including largemouth bass, smallmouth bass, spotted  
6       bass, bluegill, warmouth, redear sunfish, green sunfish, white crappie, and black crappie (California  
7       Department of Fish and Game 2008b). The increase in nonnative submerged aquatic vegetation and  
8       the reduction of spring water velocities and summer salinity due to reservoir releases for diversions  
9       when these fish are spawning are hypothesized to have probably increased populations of these fish  
10      (Brown and Michniuk 2007). Centrarchids, in conjunction with submerged aquatic vegetation, can  
11      negatively affect native fish via predation, as well as competition (Nobriga and Feyrer 2007; Brown  
12      and Michniuk 2007).

13      Anecdotal information indicates that predatory fish, including nonnative species, congregate near  
14      the four regular release locations of SWP and CVP salvage facilities (California Department of Water  
15      Resources 2005). It is thought that these predators have learned to gather near the pipe exits when  
16      flushing pumps are activated, resulting in increased risk of predation to salvaged fish. Salvaged fish  
17      are released in high concentrations in a relatively small area and upon release tend to be disoriented  
18      and stressed and are sometimes injured, reportedly resulting in higher predation rates.

## 19      **Nonnative Invertebrates**

### 20      ***Overbite Clam and Asian Clam***

21      Two species of nonnative bivalves, the Asian clam (*Corbicula fluminea*) and the overbite clam  
22      (referred to as either *Corbula amurensis* or *Potamocorbula amurensis* depending on the individual  
23      paper), are two of the major consumers of phytoplankton in the Bay-Delta (Jassby et al. 2002).

24      Proliferation of the grazing clam, *C. amurensis*, is identified as a major contributor to this shift. Based  
25      on analysis of 27 years of benthic data, Peterson and Vayssieres (2010) documented the  
26      establishment of the overbite clam during the 1987–1994 drought under high salinity conditions  
27      that favored the clam. The population has persisted and extended its geographic range within the  
28      Delta (Kimmerer and Orsi 1996, Jassby et al. 2002). This increase in the population of overbite clam  
29      resulted in profound changes to the zooplankton community. Predation (i.e., filter feeding) of  
30      copepod nauplii by overbite clams has been documented and is implicated in the decline of several  
31      species. Within 1 year after the overbite clam invasion, the abundance of three common estuarine  
32      copepods declined by 53 to 91%. (Kimmerer et al. 1994). Changes in nutrient ratios related to  
33      increased ammonia have also been linked to the changes in zooplankton species assemblages  
34      (Glibert 2011 and 2012).

35      Prior to 1987, the mysid shrimp dominated the macrozooplankton community of the Bay-Delta and  
36      was an important food item for fish, including juvenile striped bass. Following the overbite clam  
37      invasion, mysid shrimp abundance decreased sharply. Additional mysid species (e.g., *Acanthomysis*  
38      *bowmani*) have invaded the Bay-Delta, and compete with native mysid shrimp for food. Nonnative  
39      amphipod crustaceans may substitute for a depressed mysid shrimp population and a food source  
40      for juvenile fish; however, the relative contribution of this substitution is not well understood  
41      (Feyrer et al. 2003; Toft et al. 2003).

1 As filter feeders, overbite clams consume phytoplankton, bacterioplankton, and small zooplankton  
2 such as rotifers and copepod nauplii (Werner and Hollibaugh 1993; Kimmerer et al. 1994). The  
3 coincident decline of phytoplankton with the proliferation of the overbite clam indicates that the  
4 clams are over-grazing the systems (CALFED 2008; Cloern and Nichols 1985). Alternative  
5 consumers have partially replaced those existing before the overbite clam invasion. For example,  
6 introduced copepods such as *Pseudodiaptomus forbesi* have replaced *Eurytemora affinis*, and  
7 nonnative mysids have partially compensated for the loss of *Neomysis mercedis*.

8 Overbite clams eliminated summer-long phytoplankton blooms starting in 1987, but responses of  
9 zooplankton and most fish were somewhat muted. When the overbite clam invaded, northern  
10 anchovy shifted in distribution seaward, reducing summer abundance by 94% in the Bay-Delta in  
11 direct response to reduced food availability. After overbite clams became abundant, all planktivores  
12 exhibited reduced food consumption and anchovy left; the departure of the anchovy mitigated the  
13 effects of the loss of phytoplankton productivity, making a greater proportion of the reduced  
14 zooplankton productivity available to other fish species (Kimmerer 2006). The departure of the  
15 anchovy from the Delta could potentially have resulted in additional food web-related effects in the  
16 Delta that have not been evaluated.

17 In Suisun Bay, overbite clams are more reproductively active in wet years than in dry years, and this  
18 is believed to be a response to food availability/quality. During wet years, organic matter from  
19 upstream riverine sources augment food in Suisun Bay. During dry years, oceanic inputs provide a  
20 supplemental, but qualitatively different food source. Initiation and maintenance of reproductive  
21 activity is closely correlated with shifts in food availability/quality. The ability of the overbite clam  
22 to use a wide variety of food sources is a key to its success as an invasive species (Parchaso and  
23 Thompson 2002).

24 Overbite clams are preyed upon heavily by migratory waterfowl, to the point of localized depletion  
25 during winter (Pulton et al. 2004) in San Pablo Bay and Grizzly Bay. Additional predators on  
26 overbite clams include white sturgeon, green sturgeon, Sacramento splittail and dungeness crab  
27 (Stewart et al. 2004). The role of overbite clams as prey in the Bay-Delta is an important step in the  
28 transfer of contaminants to higher trophic levels. Overbite clams have been observed to  
29 bioaccumulate selenium in their tissues at concentrations high enough to induce reproductive  
30 anomalies in predators, such as waterfowl and benthic-feeding fish, including white sturgeon and  
31 Sacramento splittail, and perhaps dungeness crab (Stewart et al. 2004). The clams exhibit high  
32 tissue concentrations, which is passed up through the food web to consumers of clams.

### 33 **Introduced Copepods**

34 The species composition of copepods has changed dramatically as a result of species introductions,  
35 primarily from mainland Asia (Kimmerer and Orsi 1996; Orsi and Ohtsuka 1999). The species  
36 changes coincide with the changes in nutrient concentrations, increase in ammonia, and the pelagic  
37 organism decline (Glibert 2011). During the late 1980s and early 1990s, the nonnative copepod  
38 *Pseudodiaptomus forbesi* largely replaced *Eurytemora affinis* as the overbite clam became abundant  
39 in the low-salinity reaches of the estuary. *E. affinis* still achieves high population levels during  
40 spring, but is replaced by *P. forbesi* in late spring-early summer. While small native fish such as  
41 longfin smelt and delta smelt can switch between both prey species, *P. forbesi* is a faster swimmer  
42 than *E. affinis*, and may therefore be able to avoid predators more effectively. The introduced  
43 cyclopoid copepod *Limnoithona tetraspina* has, since the early 1990s, become the most abundant  
44 copepod in the upper estuary (Bouley and Kimmerer 2006). However, the relatively non-motile, or

1 sedentary, nature of this species makes it less available as a food source for smelt and other small  
2 predatory fish.

3 The nonnative cyclopoid copepod *Limnoithona tetraspina* increased in abundance in the Suisun Bay  
4 region in the mid-1990s (Bouley and Kimmerer 2006). Because of its small size, sedentary behavior,  
5 and ability to detect and avoid predators, this species is considered an inferior prey item relative to  
6 the native copepod species. An additional nonnative calanoid copepod, *Acartiella sinensis*, also  
7 achieved high densities in Suisun Bay during the past decade. The suitability of this species as a fish  
8 prey item has yet to be fully determined. From 1993 to 1996, *L. tetraspina* rarely made up more than  
9 10% of the diet of juvenile delta smelt, although they represented up to 80% of the total  
10 phytoplankton community (Bouley and Kimmerer 2006).

11 The calanoid copepod *Pseudodiaptomus forbesi*, which replaced *Eurytemora affinis* as the most  
12 abundant prey item for delta smelt in summer in response to the invasion of overbite clam during  
13 1987 and 1988, declined in the Suisun Marsh and confluence regions from 1995 to 2004, while  
14 simultaneously increasing in the southern Delta region.

15 Eight East Asian pelagic copepods are known to have been introduced over the period from the early  
16 1960s to the mid-1990s: *Acartiella sinensis*, *Limnoithona sinensis*, *Limnoithona tetraspina*, *Oithona*  
17 *davisae*, *Pseudodiaptomus forbesi*, *Pseudodiaptomus marinus*, *Sinocalanus doerri*, and *Tortanus*  
18 *dextrilobatus* (Orsi and Ohtsuka 1999). *A. sinensis*, a stenothermal tropical species that is native to  
19 south China and Thailand, has become abundant in Suisun Bay during the past decade. The  
20 suitability of this species as a fish prey item has yet to be fully determined. Both species of  
21 *Limnoithona* are native to China, with *L. sinensis* occupying freshwater reaches of its native estuaries  
22 (e.g., the Yangtze River) and *L. tetraspina* occurring in low-salinity reaches. *L. tetraspina* is now the  
23 most abundant copepod in the upper San Francisco Estuary (Bouley and Kimmerer 2006). This  
24 species is small and, in contrast to most native copepods, feeds on ciliates rather than  
25 phytoplankton. Because of its size and sedentary nature, *L. tetraspina* does not appear to be an  
26 important prey item for Bay-Delta fish. *O. davisae* is regarded as a coastal species in East Asian  
27 estuaries where it originates, although it may occur throughout the brackish water zone. *P. forbesi*  
28 replaced *E. affinis* as the most abundant prey item for delta smelt in summer, in response to the  
29 invasion of the overbite clam. This species declined in the Suisun Marsh and confluence regions from  
30 1995 to 2004, while simultaneously increasing in the southern Delta region. *S. doerri*, like *L. sinensis*,  
31 occurs primarily in the freshwater reaches of its native East Asian estuaries. *Tortanus dextrilobatus*,  
32 native to Chinese and Korean estuaries, is carnivorous, preying upon other copepods, including  
33 *Oithona* and *Acartia*. This species has been recorded to achieve densities in excess of 1,000  
34 individuals per cubic meter in the Bay-Delta (Hooff and Bollens 2004).

### 35 **Chinese Mitten Crab**

36 The Chinese mitten crab is native to coastal rivers and estuaries of China and South Korea that drain  
37 to the Yellow Sea. Chinese mitten crabs were introduced to Germany in the early 1900s, colonized,  
38 and became established in numerous estuaries throughout Europe during the early 20th century.  
39 Chinese mitten crabs were first collected in the San Francisco Estuary in the early 1990s, but likely  
40 introduced to South San Francisco Bay (South Bay) in the late 1980s Interagency Ecological Program  
41 2006). Chinese mitten crabs reached the Delta by 1996, and by 1998 had traveled up the watershed  
42 as far north as Colusa County and east to Merced County. During their invasion, the crabs became a  
43 nuisance among commercial fishing activities in the lower estuary and were reported in high  
44 densities on intake screens at water withdrawal facilities throughout the Bay-Delta.

1 After several years of rapid population growth and expanding distribution, Chinese mitten crabs  
2 experienced a population boom in the late 1990s. All data sources indicate that the population has  
3 been declining since then (Interagency Ecological Program 2006, 2007, 2008). In 2005, the San  
4 Francisco Bay Study adult mitten crab mean catch-per-unit-effort was the lowest since 1996  
5 (Interagency Ecological Program 2006). The combined SWP and CVP estimated total salvage was 18  
6 adults during fall 2005, the lowest since mitten crabs were first detected at the CVP fish salvage  
7 facility during fall 1996 (Interagency Ecological Program 2006). In 2006, the combined mitten crab  
8 salvage at the SWP and CVP fish facilities was 12 adults (Interagency Ecological Program 2007). In  
9 fall and winter of 2007–2008, no mitten crabs were collected at either fish facility, or by the San  
10 Francisco Bay Study or the University of California (U.C.) at Davis Suisun Marsh trawl surveys  
11 (Interagency Ecological Program 2008). Also, there were no reports of adult mitten crabs in the  
12 South Bay, the first year since 1994 that none were collected there (Interagency Ecological Program  
13 2008). USFWS monitoring for juvenile mitten crabs in Delta tributaries detected no mitten crabs in  
14 2005, 2006, or fall and winter of 2007–2008 (Interagency Ecological Program 2006, 2007, 2008).

15 From 2000 through 2003, the highest numbers of adult mitten crabs at the SWP and CVP fish  
16 facilities occurred from September through December, during their downstream migration for  
17 reproduction (Interagency Ecological Program 2001, 2002, 2003, 2004). Chinese mitten crabs were  
18 considered a nuisance at the fish facilities because they interfered with the effective salvage of fish  
19 (Interagency Ecological Program 2001, 2002, 2003, 2004). However, mitten crabs have generally  
20 become undetectable in the Delta surveys and at the SWP and CVP fish facilities in recent years.  
21 Because it is not yet understood what controls the estuary's mitten crab population (Interagency  
22 Ecological Program 2006), mitten crabs could potentially become a concern again in the future.

### 23 ***Other Invasive Invertebrates***

24 Other invasive invertebrates in the Bay-Delta include the mysid shrimp, which has largely replaced  
25 *N. mercedis*; the amphipod, *Gammarus daiberi*, which may have partially taken the place of native  
26 mysids in the food web (Kimmerer 2004); and the grass shrimp, which supports a commercial bait  
27 fishery along with several species of native Crangonid shrimp. CALFED (2000a) recommended that  
28 the potential interactions between grass shrimp and mitten crabs be examined. Two species of  
29 jellyfish, believed to be native to the Black and Caspian Seas, are now established in Suisun Bay.  
30 There is concern regarding the potential of these predatory jellyfish to alter zooplankton  
31 communities and feed directly on larvae and early juveniles of native and nonnative fish, although  
32 the extent to which this has occurred remains undocumented (Rees and Gershwin 2000).

33 Quagga mussels have become established in several reservoirs in southern California, and zebra  
34 mussels are established in San Justo Reservoir in San Benito County in central California. Thus, it is  
35 possible that Quagga and zebra mussels may invade the Bay-Delta in the near future. San Justo  
36 Reservoir is closed to public access, thereby reducing the risk of that as a source for zebra mussels  
37 spreading to the Delta. However, many of the Quagga-infested southern California reservoirs are still  
38 open to boating and fishing, and with these multiple sources, Quagga mussels are expected to arrive  
39 in the Delta first. Quagga and zebra mussels are filter feeders like the Asian and overbite clams and  
40 would likely further deplete phytoplankton and zooplankton resources in upper, freshwater portion  
41 of the Delta. Conservation Measure (CM) 20 will establish a Recreational Users Invasive Species  
42 Program, which will include education and outreach and water inspection programs to help prevent  
43 the introduction of Quagga and zebra mussels and other nonnative species into the Delta.

## 1 **Macrophytes**

### 2 ***Brazilian Waterweed***

3 Brazilian waterweed *Egeria* became established in shallow littoral areas of the upper Bay-Delta  
4 during the mid 1980s. From 2004 to 2006, the distribution of Brazilian waterweed increased by  
5 more than 10% per year.

6 Brazilian waterweed has many detrimental effects on the Bay-Delta ecosystem, as it traps  
7 suspended sediment in the water column, inducing deposition and a change in the texture and  
8 organic content of underlying shallow-water sediments. Water circulation is impeded in areas of  
9 dense waterweed growth, and local increases in water temperature may occur. This increase in  
10 water clarity reduces habitat suitability for native fish such as the delta smelt, and simultaneously  
11 enhances habitat suitability for nonnative species, notably centrarchids (e.g., black bass and  
12 sunfish). Small prey species which use turbidity as a refuge from predation are potentially at an  
13 increased risk indirectly in a system with increased water clarity. Proposals to breach levees and  
14 create shallow water habitat in portions of the Delta carry the risk of spreading Brazilian  
15 waterweed, further exacerbating these habitat changes. Currently, the only option for removal or  
16 control of Brazilian waterweed is intensive mechanical removal and herbicide application.

### 17 ***Other Invasive Aquatic Plants***

18 In addition to Brazilian waterweed *Egeria*, a number of other nonnative aquatic plant species have  
19 become established in the Bay-Delta.

- 20 ● Water hyacinth, which was first identified in the Bay-Delta in 1904, and is locally abundant in  
21 quiet waters
- 22 ● Milfoils
- 23 ● Curly-leaf pondweed
- 24 ● Carolina fanwort

25 Water hyacinth has proliferated and displaced beds of the native pennywort although pennywort  
26 will expand where water hyacinth has been removed or died back. California began controlling  
27 water hyacinth in the early 1980s via aerial spraying of herbicide, or direct application to the beds  
28 from boats. Mechanical removal causes the plant to multiply, as new plants can develop from plant  
29 fragments (California Department of Boating and Waterways 2010). Chapter 12, *Terrestrial*  
30 *Biological Resources*, provides additional discussion of nonnative invasive plant species including  
31 aquatic plants.

## 32 **11.1.5.4 Harvest and Hatchery Management**

33 California's anadromous fish hatcheries, constructed to mitigate for the salmon and steelhead  
34 production lost as a result of dam construction, provide a substantial portion of the harvest of  
35 California fall-run Chinook salmon. Barnett-Johnson et al. (2007) found that approximately 10%  
36 ( $\pm 6\%$ ) of Chinook salmon harvested in the central California ocean fishery were of wild origin, with  
37 the remainder believed to be hatchery-produced. In supplying fish for commercial and recreational  
38 use, California's hatcheries are to be operated in such a way that the populations and genetic  
39 integrity of salmon and steelhead stocks are maintained, with management emphasis placed on

1 natural stocks (California Department of Fish and Game and National Marine Fisheries Service  
2 2001).

3 There is little information on steelhead harvest rates in California. The average annual harvest rate  
4 of adult steelhead above RBDD for the 3-year period from 1991–1992 through 1993–1994 was 16%  
5 (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose  
6 fin clip allowing anglers to distinguish hatchery and wild steelhead to protect wild steelhead.  
7 Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams.  
8 Overall, this regulation has greatly increased protection of naturally produced adult steelhead.  
9 However, the total number of Central Valley steelhead contacted might be a significant fraction of  
10 basin-wide escapement, and even low catch-and-release mortality may pose a problem for wild  
11 populations (Good et al. 2005).

## 12 Harvest

13 Commercial, recreational, and tribal fisheries represent a potential stressor to Delta fish. The ocean  
14 commercial, and ocean and inland recreational fisheries for Chinook salmon are of mixed stock,  
15 comprised of both wild and hatchery-produced salmon. Because there are fewer naturally produced  
16 Chinook salmon, their populations likely are less able to withstand high harvest rates compared to  
17 hatchery-based stocks. Thus, harvest has the potential to result in detrimental effects on wild  
18 spawners in the mixed stock fishery. However, although harvest is considered a serious stressor on  
19 Chinook salmon populations, it is not considered a serious stressor in the Delta.

20 There are no commercial fisheries for steelhead in the ocean. However, inland steelhead fisheries  
21 include tribal and recreational fisheries. An important recreational fishery for steelhead occurs  
22 throughout the Central Valley, but harvest is restricted to visibly marked fish (adipose fin clip) of  
23 hatchery origin, thereby reducing the likelihood of impacting naturally spawned wild fish. The  
24 effects of recreational fishing and the unknown level of illegal harvest on the abundance and  
25 population dynamics of wild Central Valley steelhead have not been quantified (SAIC 2009).

26 In California, it is unlawful for green sturgeon to be taken or possessed for commercial or  
27 recreational purposes (California Department of Fish and Game 2010c). Green sturgeon can be  
28 caught incidentally while fishing for white sturgeon, but must be released. Hooking mortality may  
29 occur due to incidental catches. Reductions in productivity may occur if gravid females abort their  
30 spawning runs following capture and return downstream without spawning due to excessive stress  
31 from the capture and release process. The proportion of the population that exhibits this behavior is  
32 unknown. Illegal harvest of sturgeon is known to occur in the Sacramento River, particularly in  
33 areas where sturgeon have become concentrated, as well as throughout the Delta.

34 Poaching also represents a form of harvest. California has the lowest game warden-to-population  
35 ratio in the nation, with fewer than 200 field wardens for the entire state. The Delta-Bay Enhanced  
36 Enforcement Program is a 10-warden squad that was formed specifically to increase enforcement  
37 on poaching of anadromous fish species in Bay-Delta waterways. The Delta is a particular hot spot  
38 for poaching because of the large number of sportfish, particularly gravid female white sturgeon,  
39 whose roe are used for caviar. Illegal harvest is thought to have high impacts on sturgeon  
40 populations, particularly white sturgeon. Poaching may be less significant than incidental take  
41 associated with white sturgeon sportfishing (Williamson 2003). However, the tendency for green  
42 sturgeon to form aggregations for long periods may make them easy targets for poachers (Erickson  
43 et al. 2002).

## 1 Hatcheries

2 Five anadromous fish hatcheries upstream of the Plan Area contribute to the propagation of  
 3 steelhead and Chinook salmon. There are no hatcheries in the Plan Area. The influence of  
 4 anadromous fish hatchery practices on salmon population viability is an ongoing concern based on  
 5 the potential risks the hatcheries can have on wild salmonid population genetics, ecology, health,  
 6 behavior, and on overfishing (National Marine Fisheries Service 2010). The risks described by NMFS  
 7 (2010) and summarized below apply to conventional hatcheries; current hatchery practices, such as  
 8 conservation hatcheries and program (e.g., Livingston Stone Fish Hatchery for winter-run Chinook  
 9 salmon), are designed to reduce these risks. Despite the potential risks, hatcheries have valuable  
 10 roles for meeting conservation and recovery goals for salmonids and other species, as well as  
 11 commercial and recreational harvest needs. However, the extent that hatchery produced adults can  
 12 alter the population dynamics or fitness of natural populations remains largely unquantified (Naish  
 13 et al. 2007).

## 14 Genetic Risks

15 Human intervention in the rearing of wild animals such as within conventional anadromous fish  
 16 hatcheries has the potential to cause genetic change. These genetic changes impact salmon diversity  
 17 and the health of salmon populations. Hatchery programs vary as can the risks identified below vary  
 18 by hatchery. NMFS (2010) reported the following genetic risks of artificial propagation on wild  
 19 populations.

- 20 • ***Inbreeding*** – Inbreeding can occur when the hatchery broodstock comes from a small  
 21 percentage of the total wild and/or hatchery fish stock (e.g., 100 adults are used out of a  
 22 population of 1 million). Using a small portion of a population to create a hatchery stock can  
 23 reduce genetic diversity. Inbreeding can affect the survival, growth, and reproduction of salmon.
- 24 • ***Intentional or artificial selection for a desired trait (e.g., growth rate or fecundity)*** – Some  
 25 hatchery programs intentionally select for specific traits that change the genetic makeup of the  
 26 hatchery stock, moving it further away from naturally reproducing salmon stocks.
- 27 • ***Selection resulting from nonrandom sampling of broodstock*** – The makeup of a hatchery  
 28 population comes from a selection of wild salmon and/or returning hatchery salmon that are  
 29 taken into captivity (i.e., broodstock). If, for example, only early-returning adults are used as  
 30 broodstock instead of adults that are representative of the population as a whole (i.e., early-,  
 31 normal-, and late-returning adults), there will be genetic selection for salmon that return early.
- 32 • ***Unintentional or natural selection that occurs in the hatchery environment*** – Conditions in  
 33 hatchery facilities differ greatly from those in natural environments. Hatcheries typically rear  
 34 fish in vessels (i.e., circular tanks and production raceways) that are open and have lower and  
 35 more constant water flow than that which occurs in natural streams and rivers. They also tend  
 36 to hold fish at higher densities than those that occur in nature. This type of environment has the  
 37 potential to alter selection pressures in favor of fish that best survive in hatchery, not natural,  
 38 environments.
- 39 • ***Temporary relaxation during the culture phase of selection that otherwise would occur in***  
 40 ***the wild*** – Artificial mating disrupts natural patterns of sexual selection. In hatcheries,  
 41 humans—not the salmon—select the adult males and females to mate. Humans have no way of  
 42 knowing which fish would make the best natural breeders. In addition, selection is relaxed up  
 43 until the time when juveniles are released from the hatchery (because they do not face the same

1 predation and foraging challenges as wild juvenile fish). Fish raised in hatchery environments  
2 face very different pressures than those raised in the wild.

### 3 **Ecological Risks**

4 Hatchery-produced fish often differ from wild fish in their behavior, appearance, and/or physiology.  
5 Ecological risks of artificial propagation on wild populations as reported by NMFS (2010) include:

- 6 • **Competition for food and territory** – Competition between wild and hatchery fish is most likely  
7 to occur if the fish are of the same species (e.g., wild Chinook salmon and hatchery- reared  
8 Chinook salmon) and they share the same habitat and diet in the freshwater/estuarine  
9 environment.
- 10 • **Predation by larger hatchery fish** – If hatchery-released salmon are larger than wild salmon,  
11 evidence suggests that, for certain species, hatchery-released salmon may prey on wild salmon.
- 12 • **Negative social interactions** – Juvenile salmon establish and defend foraging territories  
13 through aggressive contests. When large numbers of hatchery fish are released in streams  
14 where there are small numbers of wild fish, hatchery fish are more likely to be more aggressive,  
15 disrupting natural social interactions.
- 16 • **Carrying capacity issues** – Carrying capacity is a measure of the amount of a population (i.e.,  
17 number of salmon) that can be supported by a particular ecosystem. Carrying capacity changes  
18 over time with the abundance of predators and resources such as food and habitat. When  
19 hatchery fish are released into streams where there are wild fish, there can be competition for  
20 food and space.

### 21 **Behavioral**

22 Hatchery environments are different than stream environments that can produce fish that tend to  
23 have different foraging, social, and predator-avoidance behavior during the freshwater and  
24 estuarine rearing and outmigration life stage (National Marine Fisheries Service 2010).

### 25 **Overfishing**

26 Large-scale releases of hatchery Chinook salmon have supported commercial, tribal, and  
27 sportfishing practices for many years. Hatchery fish are more productive than natural fish and they  
28 can produce more recruits per spawner. The commercial and recreational harvest of hatchery fish in  
29 mixed-stock ocean fisheries at harvest rates which naturally produced stocks can sustain will  
30 usually result in underharvest of hatchery fish. Hatchery fish returns to the Central Valley have  
31 increase substantially in recent years, and so have the levels of in-river recreational harvest  
32 (California Department of Fish and Game and National Marine Fisheries Service 2001). Because  
33 hatchery populations have high survival in the hatcheries, they can generally support higher harvest  
34 rates. Wild stocks, on the other hand, are typically much smaller, and their population could be  
35 harmed by such high harvest rates. NMFS and fisheries managers are currently implementing  
36 programs that allow for the selective harvest of hatchery fish (i.e., harvest that does not impact wild  
37 stocks). Selective harvest opportunities could be supported through catch and release programs,  
38 based on marking/tagging hatchery fish for easy recognition, and/or in places where hatchery  
39 stocks are isolated from wild stocks (i.e., if hatchery stocks use a different stream or enter the  
40 stream at a different time than wild stocks) (National Marine Fisheries Service 2010).

## 1 **Fish Health**

2 The effects of disease on hatchery fish and their interaction with wild fish are not well understood.  
 3 Hatcheries can have disease outbreaks, which can result in the transfer of disease from released  
 4 hatchery fish to wild fish. Once released, these fish can transmit disease to wild fish (National  
 5 Marine Fisheries Service 2010). For example, infectious hematopoietic necrosis virus is of particular  
 6 significance on the Feather River, as there have been rather severe outbreaks of this virus in the  
 7 Feather River Fish Hatchery (California Department of Water Resources 2004b).

### 8 **11.1.5.5 Pelagic Organism Decline**

9 The four primary pelagic fish of the upper estuary (delta smelt, longfin smelt, striped bass, and  
 10 threadfin shad), have shown substantial variability in their populations, with evidence of long-term  
 11 declines for the first three of these species (Baxter et al. 2008). However, surveys showed that  
 12 population levels for these four pelagic species began to decline sharply around 2000, despite  
 13 relatively moderate hydrology, which typically supports at least modest fish production (Sommer et  
 14 al. 2007). Data showed continuing declines over the next several years; abundance indices for 2002  
 15 to 2009 included record lows for delta smelt and age-0 striped bass, and near-record lows for  
 16 longfin smelt and threadfin shad. By 2004, these declines became widely recognized and discussed  
 17 as a serious management issue, and collectively became known as the “pelagic organism decline”  
 18 (POD). Delta smelt numbers increased in 2011 but were still low  
 19 (<http://cdfgnews.wordpress.com/2011/12/22/endangered-delta-smelt-population-improves-2/>)  
 20 The POD focuses on fish that rely on the pelagic zone for spawning, early life history, and perennial  
 21 habitat. The POD’s integration of the many factors that comprise the Delta’s complex ecosystem  
 22 addresses the disturbance and loss of aquatic habitats common within the Delta. In evaluating this  
 23 phenomenon, an interagency team has attempted to integrate the wide range of potential stressors  
 24 and threats to the POD species. Evaluation of the Delta fish community will rely heavily on these  
 25 evaluations and extend consideration of these relationships to all pertinent aquatic resources in the  
 26 Delta. The apparent simultaneous declines of these four fish species occurred despite differences in  
 27 their life histories and in how each species utilizes Delta habitats. These differences suggested one  
 28 or more Delta-wide factors to be important in the declines (Baxter et al. 2008). The following  
 29 description of the POD is taken directly from Sommer et al. (2007:273–274).

30 “...The San Francisco Estuary is physically very dynamic, so it is not surprising that annual  
 31 abundance of all of these populations is extremely variable, and that much of this variability is  
 32 associated with hydrology...the grazing effects from *Corbula* are thought to have resulted in a  
 33 substantial decline in phytoplankton and calanoid copepods, the primary prey of early life stages  
 34 of pelagic fishes...”

35 A conceptual model was developed to aid in the evaluation of the POD, and to describe possible  
 36 mechanisms by which a combination of long-term and recent changes in the ecosystem could  
 37 produce the observed pelagic fish declines (Baxter et al. 2008). The conceptual model is intended to  
 38 assess how different stressors may be linked to the POD, and is based on classical food web and  
 39 fisheries ecology. It contains four major components: (1) prior fish abundance levels; (2) habitat; (3)  
 40 top-down effects; and (4) bottom-up effects (Baxter et al. 2008). This conceptual model is being  
 41 used by various groups to evaluate the recently observed declining trends in pelagic species in the  
 42 Delta. Some of the concepts associated with the model are important for understanding potential  
 43 effects of anthropogenic changes to the aquatic ecosystem.

- 44 ● **Prior fish abundance levels.** Describes how continued low abundance of adults leads to  
 45 reduced juvenile production (i.e., stock-recruit effects). Stock-recruitment mechanisms and

1 survival among life stages have changed from that reported in earlier pre-POD work. Striped  
 2 bass, longfin smelt, and threadfin shad previously were able to recover from low abundances,  
 3 but now show limited resilience. Delta smelt reportedly exhibit a significant stock-recruitment  
 4 relationship, possibly because adult abundance is exceptionally low and thus summer survival is  
 5 a less important factor than it may have been in controlling the population abundance (Baxter et  
 6 al. 2008).

- 7 • **Habitat.** Describes how water quality variables (including contaminants and toxic algal blooms)  
 8 affect estuarine species, and assumes that habitat quality and abundance (e.g., water quality and  
 9 hydrology) affect survival and reproduction. New analyses of water quality data collected  
 10 concurrently with fish data highlight the importance of Secchi depth (i.e., water clarity or  
 11 turbidity), specific conductance (a surrogate for salinity), and water temperature. These  
 12 relationships vary according to season for the three POD species inhabiting the Delta for which  
 13 data were analyzed and have focused discussions regarding “good habitat” for pelagic fish. Some  
 14 incidences of contaminant effects have been observed in bioassay tests of Delta waters;  
 15 however, the importance of these results for POD fish or other Delta species has yet to be  
 16 determined (Baxter et al. 2008).
- 17 • **Top-down effects.** Assumes that predation and SWP and CVP water project operations (e.g.,  
 18 entrainment at the pumps) affect mortality rates. Striped bass and largemouth bass are believed  
 19 to be the major predators on larger fish in the Delta. The importance of striped bass as a  
 20 predator on fish is well known, and there is no indication of a major change during the years of  
 21 the POD. Largemouth bass have become more abundant concurrent with the invasion of  
 22 Brazilian waterweed *Egeria*, which has increased habitat for largemouth bass and other invasive  
 23 species. Although the increase in largemouth bass seems an unlikely single cause for the POD  
 24 declines, the increase may be a contributing factor and could make recovery more difficult.  
 25 Entrainment at the SWP and CVP pumps also appears to be an unlikely single cause of the POD,  
 26 but may be important for some species during certain years. Removal of pre-spawning delta  
 27 smelt by the SWP and CVP pumps may be especially important. Recent analyses have focused on  
 28 the importance of reverse flows in Old and Middle Rivers and the possible importance of  
 29 turbidity as an environmental trigger for upstream migration of delta smelt and longfin smelt  
 30 (Baxter et al. 2008).
- 31 • **Bottom-up effects.** Assumes that food web interactions affect survival and reproduction, and  
 32 focuses on food availability and food web interactions (e.g., competition, invasives, nutrients, X2,  
 33 food quality, and co-occurrence) in Suisun Bay and the west Delta. The importance of co-  
 34 occurrence of fish with food continues to be a key area of interest. Much of this discussion of  
 35 bottom-up effects in the conceptual model focuses on food resources for delta smelt. Overall, the  
 36 total biomass of zooplankton has not changed substantially in delta smelt summer habitat;  
 37 however, species composition reportedly has changed. New investigations focus on zooplankton  
 38 availability (i.e., can delta smelt catch them) and whether there are differences in energetic  
 39 profitability among prey (i.e., does it take more energy to catch) (Baxter et al. 2008).

40 An update to the POD work plan and synthesis of results also reports that an emerging conclusion is  
 41 that POD was driven by multiple and interacting factors (Baxter et al. 2010). Consequently, two  
 42 additional approaches are being considered. One approach focuses on how major drivers differ for  
 43 each of the four POD species and their individual life stages. The second approach considers  
 44 whether an ecological regime shift may be affecting the entire estuarine ecosystem and considers  
 45 the effects of changing drivers through different historical periods leading up to the POD.

## 11.2 Regulatory Setting

This section provides the regulatory setting for aquatic resources, including potentially relevant federal, state, and local requirements applicable to the BDCP.

### 11.2.1 Federal Plans, Policies, and Regulations

#### 11.2.1.1 Federal Endangered Species Act

The ESA requires that both USFWS and NMFS maintain lists of threatened and endangered species. An “endangered species” is defined as “...any species which is in danger of extinction throughout all or a significant portion of its range.” A “threatened species” is defined as “...any species that is likely to become an Endangered Species within the foreseeable future throughout all or a significant portion of its range” (Title 16 U.S. Code [USC] Section 1532). Section 9 of the ESA makes it illegal to “take” (i.e., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct) any endangered species of fish or wildlife, and regulations contain similar provisions for most threatened species of fish and wildlife (16 USC 1538).

The ESA also requires the designation of “critical habitat” for listed species. “Critical habitat” is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential for the conservation of the species, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation of the species (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:xiii; National Marine Fisheries Service 2009a).

Section 7 (a)(2) of the ESA requires all federal agencies to ensure that any action they authorize, fund, or carry-out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. To ensure against jeopardy, each federal agency must consult with USFWS or NMFS, or both, if the federal agency determines that its action might affect listed species. NMFS jurisdiction under the ESA is limited to the protection of marine mammals, marine fish, and anadromous fish; all other species are within USFWS jurisdiction.

If an activity proposed by a federal agency would result in the take of a federally listed species, the consulting agency will issue a Biological Opinion analyzing the effects of the proposed action on listed species and an Incidental Take Statement if appropriate. The Incidental Take Statement typically requires various measures to avoid and minimize species take.

Where a federal agency is not authorizing, funding, or carrying out a project, take that is incidental to the lawful operation of a project may be permitted pursuant to Section 10(a) of the ESA through approval of an HCP and issuance of an incidental take permit.

#### Critical Habitat Designations for Species

Delta smelt critical habitat was designated on December 19, 1994 (59 FR 65256), and includes “areas of all water and all submerged lands below ordinary high water and the entire water column bounded by and constrained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the

1 length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the  
2 existing contiguous waters contained within the Delta.”

3 NMFS designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212).  
4 Critical habitat was delineated as the Sacramento River from Keswick Dam at river mile (RM) 302 to  
5 Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta), including  
6 Kimball Island, Winter Island, and Brown’s Island; all waters from Chipps Island westward to the  
7 Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters  
8 of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the  
9 San Francisco-Oakland Bay Bridge. In the Sacramento River, critical habitat includes the river water  
10 column and substrate and the adjacent riparian zone. Westward of Chipps Island, critical habitat  
11 includes the estuarine water column and essential foraging habitat and food resources used by  
12 Sacramento River winter-run Chinook salmon as part of their juvenile emigration or adult spawning  
13 migration.

14 Critical habitat was designated for Central Valley spring-run Chinook salmon on September 2, 2005  
15 (70 FR 52488). Critical habitat for Central Valley spring-run Chinook salmon occurs in the Plan Area,  
16 and includes stream reaches such as those of the Feather and Yuba rivers, Big Chico, Butte, Deer,  
17 Mill, Battle, Antelope, and Clear creeks, the main stem of the Sacramento River from Keswick Dam  
18 through the Delta; and portions of the network of channels in the northern Delta. Critical habitat  
19 includes the stream channels in these designated waters up to the ordinary high-water line or  
20 bankfull elevation (elevation generally with a recurrence interval of 1 to 2 years).

21 Critical habitat was designated for steelhead in the Central Valley on September 2, 2005 (70 FR  
22 52488). Critical habitat for Central Valley steelhead occurs within the Plan Area, and includes the  
23 stream channels to the ordinary high water line within designated stream reaches such as those of  
24 the American, Feather, and Yuba rivers, and Deer, Mill, Battle, Antelope, and Clear creeks in the  
25 Sacramento River basin; the Calaveras, Mokelumne, Stanislaus, and Tuolumne rivers in the San  
26 Joaquin River basin; and the Sacramento and San Joaquin rivers and the entire Delta.

27 Critical habitat was designated for the southern DPS of North American green sturgeon on October  
28 9, 2009, (74 FR 52345). The designation includes the stream channels and waterways in the  
29 Sacramento – San Joaquin River Delta to the ordinary high water line, and also includes the main  
30 stem Sacramento River upstream from the I Street Bridge to Keswick Dam, and the Feather River  
31 upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, as well as the  
32 estuaries of San Francisco Bay, Suisun Bay, and San Pablo Bays.

### 33 **11.2.1.2 Long-Term Central Valley 2008 and 2009 USFWS and NMFS** 34 **Biological Opinions**

35 In 2008, Reclamation and DWR prepared a Biological Assessment on the continued long- term  
36 operation of the CVP and SWP. The Biological Assessment described how Reclamation and DWR  
37 intended to operate the CVP and the SWP to divert, store, and convey water consistent with  
38 applicable law from 2008 through 2025 (Bureau of Reclamation 2008a).

### 39 **U.S. Fish and Wildlife Service Biological Opinion**

40 The 2008 USFWS BiOp concurred with Reclamation’s determination that the coordinated operations  
41 of the SWP and CVP are not likely to adversely affect listed species, with the exception of delta smelt  
42 (U.S. Fish and Wildlife Service 2008). The USFWS concluded that the coordinated operation of the

1 SWP and CVP, as proposed, was likely to jeopardize the continued existence of the delta smelt, and  
2 adversely modify delta smelt critical habitat.

3 The USFWS, in cooperation with Reclamation, developed a reasonable and prudent alternative  
4 (RPA), consisting of a number of components and actions to avoid the likelihood of jeopardizing the  
5 continued existence or the destruction or adverse modification of critical habitat for delta smelt.  
6 These actions include: (1) preventing/reducing entrainment of delta smelt at Jones and Banks  
7 pumping plants; (2) providing adequate habitat conditions that will allow the adult delta smelt to  
8 successfully migrate and spawn in the Bay-Delta; (3) providing adequate habitat conditions that will  
9 allow larvae and juvenile delta smelt to rear; and (4) providing suitable habitat conditions that will  
10 allow successful recruitment of juvenile delta smelt to adulthood. In addition, USFWS specified that  
11 it is essential to monitor delta smelt abundance and distribution through continued sampling  
12 programs through the IEP. The RPA reduced reverse flows in Old and Middle Rivers, channels  
13 leading to the state and federal diversions, when delta smelt are at increased risk of entrainment.  
14 Limiting reverse flows may reduce pump operations and can limit or delay deliveries of water to  
15 SWP and CVP contractors south of the Delta.

16 In March, 2009, SWP and CVP contractors and others filed lawsuits in federal court challenging the  
17 2008 BiOp. On December 14, 2010, Judge Wanger issued a Memorandum Decision on cross motions  
18 for summary judgment in litigation concerning the USFWS 2008 BiOp which found several aspects  
19 of the BiOp flawed and directed that they be addressed on remand. An amended Final Judgement  
20 issued May 28, 2011 remanded the BiOp to USFWS for further consideration and directed USFWS to  
21 issue a revised BiOp in accordance with the Memorandum Decision.

22 The operations of the SWP and CVP are currently subject to the terms and conditions of this BiOp  
23 until a new BiOp is issued.

## 24 **National Marine Fisheries Service Biological Opinion**

25 The NMFS BiOp (National Marine Fisheries Service 2009a) concluded that the SWP and CVP  
26 operations are likely to jeopardize the continued existence of the species listed below.

- 27 ● Sacramento River winter-run Chinook salmon
- 28 ● Central Valley spring-run Chinook salmon
- 29 ● Central Valley steelhead
- 30 ● Southern DPS of North American green sturgeon
- 31 ● Southern resident killer whale

32 NMFS (2009a) also concluded that the proposed action is likely to destroy or adversely modify the  
33 designated critical habitats of Sacramento River winter-run Chinook salmon, Central Valley spring-  
34 run Chinook salmon, Central Valley steelhead, and green sturgeon.

35 The operations of the SWP and CVP are currently subject to the RPA and terms and conditions of  
36 this BiOp, until a new BiOp is issued. The actions included in the RPA to the proposed action are  
37 summarized below (National Marine Fisheries Service 2009a).

- 38 ● A new year-round temperature and Shasta Reservoir storage management program to minimize  
39 effects on endangered winter-run Chinook salmon that spawn only in the Sacramento River, as

- 1 well as long-term passage prescriptions at Shasta Dam and re-introduction of winter-run  
2 Chinook salmon to its native habitat in the McCloud River and/or upper Sacramento River.
- 3 • Maintenance of current flow and water temperature conditions in Clear Creek.
  - 4 • Modified RBDD gate operations while an alternative diversion structure is being built; complete  
5 gate removal by 2012.
  - 6 • Short-term and long-term actions for improving juvenile rearing habitat in the lower  
7 Sacramento River and northern Delta.
  - 8 • Additional DCC gate closures to keep young fish out of artificial channels in the Delta and allow  
9 them to migrate safely toward the ocean.
  - 10 • New Old and Middle River reverse flow levels to limit the strength of reverse flows and reduced  
11 entrainment at the SWP and CVP facilities.
  - 12 • Use of additional technological measures at the SWP and CVP facilities to enhance screening and  
13 increase survival of fish.
  - 14 • Additional measures to improve survival of San Joaquin steelhead smolts, including increased  
15 San Joaquin River flows and export curtailments, and a new study of acoustic tagged fish in the  
16 San Joaquin River Basin to evaluate and refine these measures.
  - 17 • A new American River flow management standard, temperature management plan, additional  
18 technological fixes to temperature control structures, and, in the long-term, restoration of  
19 steelhead passage at Nimbus and Folsom Dams.
  - 20 • A year-round minimum flow regime on the Stanislaus River necessary to minimize project  
21 effects on each life stage of steelhead, including new springtime flows that will support rearing  
22 habitat formation and inundation, and create pulses that allow salmon to migrate out  
23 successfully.
  - 24 • Development of hatchery genetic management plans to increase the diversity, and therefore,  
25 resiliency of salmon to withstand a wide range of conditions.

### 26 **11.2.1.3 Magnuson-Stevens Fishery Conservation and Management Act**

27 The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable  
28 Fisheries Act (Public Law 104 to 297), was enacted primarily to establish a management system for  
29 conserving and managing commercial fisheries within the 200-mile federal waters boundary of the  
30 United States. The act also requires that all federal agencies consult with NMFS on activities or  
31 proposed activities authorized, funded, or undertaken by that agency that may adversely affect  
32 essential fish habitat (EFH) of commercially managed marine and anadromous fish species. EFH  
33 includes specifically identified waters and substrate necessary for fish spawning, breeding, feeding,  
34 or growing to maturity. EFH also includes all habitats necessary to allow the production of  
35 commercially valuable aquatic species, to support a long-term sustainable fishery, and contribute to  
36 a healthy ecosystem (16 USC 1802[10]).

37 The Pacific Fishery Management Council has designated the Delta, San Francisco Bay, and Suisun  
38 Bay as EFH to protect and enhance habitat for coastal marine fish and macroinvertebrate species  
39 that support commercial fisheries such as Pacific salmon. Because EFH only applies to commercial  
40 fisheries, this means that all Chinook salmon habitats are included, but not steelhead habitat. There  
41 are three fishery management plans (for Pacific salmon, coastal pelagic, and groundfish species)

1 issued by the Pacific Fishery Management Council that cover species occurring in the project area,  
2 and designate EFH within the entire Bay-Delta Estuary:

- 3 • Starry flounder and northern anchovy – Identified as a Monitored Species by the Pacific Coast  
4 Groundfish Fishery Management Plan (Pacific Fishery Management Council 1998, 2008)
- 5 • Pacific Sardine – Identified as an Actively Managed Species by the Coastal Pelagic Species  
6 Fishery Management Plan (Pacific Fishery Management Council 1998)
- 7 • Pacific salmon – Identified as an Actively Managed Species by the Pacific Coast Salmon Plan  
8 (Pacific Fishery Management Council 2003)

9 The northern anchovy and starry flounder are managed as Monitored Species by the Coastal Pelagic  
10 Species Fishery Management Plan and the Pacific Coast Groundfish Fishery Management Plan of the  
11 Pacific Fishery Management Council, respectively, and are subject to EFH consultation as a result.

12 Although groundfish or coastal pelagic species EFH does not occur in the Plan Area, the Plan Area is  
13 within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon  
14 Fisheries Management Plan. Freshwater EFH for Pacific salmon (Sacramento River winter-run,  
15 Central Valley spring-run, and Central Valley fall-/late fall-run Chinook salmon) in the Plan Area  
16 includes waters currently or historically accessible to salmon within the Central Valley ecosystem as  
17 described in Myers et al. (1998).

#### 18 **11.2.1.4 Recovery Plan for Sacramento-San Joaquin Delta Native Fish** 19 **Species**

20 Since the *Recovery Plan for Sacramento-San Joaquin Delta Native Fishes* was released in 1996 (U.S.  
21 Fish and Wildlife Service 1996), new information regarding the status, biology, and threats to Delta  
22 native species has emerged (California Department of Fish and Game 2008b). Ongoing revision of  
23 the plan will review the new information and develop a strategy for the conservation and  
24 restoration of Delta native fish through the identification of recovery actions that specifically  
25 address the threats to their existence. Species covered by this plan are delta smelt, longfin smelt,  
26 Sacramento splittail, and Sacramento perch.

27 The basic goal of the plan is to establish self-sustaining populations of the species of concern that  
28 will persist indefinitely (U.S. Fish and Wildlife Service 1996). A variety of actions may be needed to  
29 achieve this goal. To be effective, recovery planning must consider not only species or assemblages  
30 of species but also habitat components, specifically their structure, function and change processes.  
31 Restoration actions may also include the establishment of genetic refugia for delta smelt (California  
32 Department of Fish and Game 2008b).

#### 33 **11.2.1.5 Recovery Planning for Salmon and Steelhead in California**

34 The public *Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-*  
35 *Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population*  
36 *Segment of Central Valley Steelhead* was released in October 2009 (National Marine Fisheries Service  
37 2009b). The California Central Valley Recovery Domain extends from the upper Sacramento River  
38 Valley to the northern portion of the San Joaquin River Valley (National Marine Fisheries Service  
39 2009b).

1 For the Central Valley Chinook salmon ESUs and the steelhead DPS to achieve recovery, each  
 2 diversity group must be represented, and population redundancy within the groups must be met to  
 3 achieve diversity group recovery. Several priority recovery actions to address specific limiting  
 4 factors were identified by NMFS (2009b) to help meet recovery objectives.

- 5 • Protect and restore watershed and estuarine habitat complexity and connectivity.
- 6 • Improve understanding of life stage survival through focused research and monitoring.
- 7 • Establish at least two additional populations of winter-run Chinook salmon that are spatially  
 8 diverse and secure from natural and human-made threats.
- 9 • Develop more effective and efficient federal and state mechanisms to correct already  
 10 documented threats to listed salmonids.
- 11 • Collaboratively balance water supply and allocation with fisheries' needs through improving  
 12 criteria for water drafting, storage and dam operations, water right programs, development of  
 13 passive diversion devices and/or offstream storage, elimination of illegal diversions in priority  
 14 watersheds and streams, and other such opportunities.
- 15 • Screening appropriate water diversions and providing adequate downstream flows.
- 16 • Provide outreach to federal action agencies regarding ESA Section 7(a)(1) and carrying out  
 17 programs to conserve and recover federally listed salmonids.
- 18 • Identify and treat point and non-point source pollution to streams from wastewater, agricultural  
 19 practices, and urban environments.

#### 20 **11.2.1.6 Recovery Planning for Green Sturgeon**

21 A federal recovery outline has been written for the North American green sturgeon southern district  
 22 population segment (NMFS 2010). The recovery plan draft has not been released.

23 The Green Sturgeon Recovery Team's vision statement is: "Healthy, self-sustained, viable  
 24 populations of southern DPS green sturgeon exist within their historic range. This includes  
 25 spawning in multiple rivers, with the DPS represented by multiple strong year-classes. These green  
 26 sturgeon are sufficiently abundant, productive, and diverse in healthy ecosystems to provide  
 27 ecological and public benefits."

28 Several key recovery needs and implementation measures to address specific limiting factors were  
 29 identified by NMFS (2010) to help meet recovery objectives.

30 Additional spawning and egg/larval habitat

- 31 • Restore access to suitable habitat
- 32 • Improve potential habitat
- 33 • Establish additional spawning populations
- 34 • Ensure adequate spatial separation of spawning populations
- 35 • Ensure all spawning populations are of sufficient size to meet genetic diversity criteria

36 Research/Monitoring

- 37 • Determine current and future population abundance and distribution of all life stages

- 1       • Obtain data needed for population viability assessment
- 2       • Determine fisheries-specific discard mortality rates and effects of capture
- 3       • Identify feeding habitats and prey resources
- 4       • Determine effects of non-native species
- 5       • Determine contaminant exposure and its effects
- 6       • Determine potential effects from proposed nearshore ocean energy projects
- 7       • Determine risk from sea lion predation

#### 8       **11.2.1.7           Fish and Wildlife Coordination Act (16 USC Section 651 et seq.)**

9       The Fish and Wildlife Coordination Act (FWCA) gives the U.S. Secretary of the Interior the authority  
 10      to provide assistance to federal, state, public, or private agencies in developing, protecting, rearing,  
 11      or stocking all wildlife, wildlife resources, and their habitats (16 USC 661). Under the FWCA,  
 12      whenever waters of any stream or other water body are proposed to be impounded, diverted, or  
 13      otherwise modified by any public or private agency under federal permit, that agency must consult  
 14      with USFWS and, in California, CDFW (16 USC 661-667e, March 10, 1934, as amended 1946, 1958,  
 15      1978, and 1995). Coordination and consultation among the USACE, USFWS, and CDFW under the  
 16      FWCA has taken place and will continue to do so over the course of the environmental process for  
 17      the BDCP.

#### 18      **11.2.1.8           Clean Water Act**

19      The Clean Water Act (CWA) is a comprehensive set of statutes aimed at restoring and maintaining  
 20      the chemical, physical, and biological integrity of the nation's waters. The CWA is the foundation of  
 21      surface water quality protection in the United States (U.S. Environmental Protection Agency 2008)  
 22      Initial authority for the implementation and enforcement of the CWA rests with the U.S.  
 23      Environmental Protection Agency (USEPA); however, this authority can be exercised by states with  
 24      approved regulatory programs. In California, this authority is exercised by the State Water Board  
 25      and the Regional Water Quality Control Boards (Regional Water Boards).

26      The CWA contains a variety of regulatory and non-regulatory tools to significantly reduce direct  
 27      pollutant discharges into waters of the United States, to finance municipal wastewater treatment  
 28      facilities, and to manage polluted runoff. These tools (e.g., Section 303[d] List of Impaired Waters  
 29      and Section 404 permitting process) are employed to achieve the broader goal of restoring and  
 30      maintaining the chemical, physical, and biological integrity of the nation's waters so that they can  
 31      support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the  
 32      water."

#### 33      **Constituents of Concern Listed Under Clean Water Act Section 303(d)**

34      Section 303(d) of the federal CWA requires states to identify water bodies that do not meet water  
 35      quality standards and are not supporting their designated beneficial uses. These waters are placed  
 36      on the Section 303(d) List of Impaired Waters. This list defines low, medium, and high priority  
 37      pollutants that require immediate attention by federal and state agencies. Placement on this list  
 38      triggers development of a Total Maximum Daily Load (TMDL) Program for each water body and  
 39      associated pollutant/stressor on the list. The Central Valley Regional Water Quality Control Board

(Central Valley Water Board) is responsible for implementing the TMDL Program in California. Completed or ongoing TMDLs in the Bay-Delta region include chlorpyrifos and diazinon, DO, mercury/methylmercury, pathogens, pesticides, organochlorine pesticides, salt and boron, and selenium (Central Valley Regional Water Quality Control Board 2010). For further information on TMDLs in the Bay-Delta region, refer to Chapter 8, *Water Quality*.

### **Clean Water Act Section 404**

Section 404 of the CWA authorizes the USACE and the EPA to issue permits to regulate the discharge of “dredged or fill materials into waters of the United States” (33 USC 1344). Should activities such as dredging or filling of wetlands or surface waters be required for project implementation, then permits obtained in compliance with CWA Section 404 would be required for the project applicant(s).

### **Clean Water Act Section 401**

Section 401 of the CWA specifies that states must certify that any activity subject to a permit issued by a federal agency (e.g., USACE) meets all state water quality standards. In California, the State Water Board and the Regional Water Boards are responsible for certifying activities subject to any permit issued by the USACE pursuant to Section 404 or pursuant to Section 10 of the Rivers and Harbors Act of 1899.

#### **11.2.1.9 Rivers and Harbors Act of 1899**

Regulated under the CWA, the Rivers and Harbors Act of 1899 makes it unlawful to excavate, fill, or alter the course, condition, or capacity of any port, harbor, channel, or other areas within the reach of the act without a permit. Under Section 10 of the Rivers and Harbor Act, the USACE regulates all structures and work in navigable waters.

#### **11.2.1.10 Executive Order 11990 – Protection of Wetlands**

Executive Order 11990 calls for each federal agency, in carrying out its ordinary responsibilities, to take actions to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Federal agencies must avoid undertaking new construction located in wetlands unless no practicable alternative is available and the action includes all practicable measures to minimize harm to wetlands.

#### **11.2.1.11 Central Valley Project Improvement Act**

The Reclamation Projects Authorization and Adjustment Act of 1992 (Public Law 102-575), includes Title 34, the CVPIA. The CVPIA amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes of the CVP having equal priority with irrigation and domestic uses of CVP water and elevates fish and wildlife enhancement to a level having equal purpose with power generation. Among the changes mandated by the CVPIA was dedication of 800 thousand acre-feet of CVP yield annually to fish, wildlife, and habitat restoration. The Department of the Interior’s May 9, 2003 decision on implementation of Section 3406(b)(2) of CVPIA explains how Section 3406(b)(2) water will be dedicated and managed. Dedication of CVPIA 3406(b)(2) water occurs when Reclamation takes a fish and wildlife habitat restoration action based on recommendations of USFWS (and in consultation with NMFS and CDFW), pursuant to Section

1 3406 (b)(2). Water exports at the CVP pumping facilities have been reduced using (b)(2) water to  
2 decrease the risk of fish entrainment at the salvage facilities and also to augment river flows.

### 3 **11.2.1.12 Anadromous Fish Restoration Program**

4 An important goal identified to meet the fish and wildlife purposes of the CVPIA is to restore natural  
5 populations of anadromous fish (e.g., Chinook salmon, steelhead, green sturgeon, white sturgeon,  
6 American shad, and striped bass) in Central Valley rivers and streams to double their recent average  
7 abundance levels. The CVPIA directs the Secretary of the Interior to develop and implement a  
8 program, known as the Anadromous Fish Restoration Program, to ensure the sustainability of  
9 anadromous fish in Central Valley rivers and streams.

### 10 **11.2.1.13 National Invasive Species Act of 1996**

11 The National Invasive Species Act (Public Law 104-332), reauthorizes and amends the  
12 Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 to mandate regulations to  
13 reduce environmental and economic impacts from invasive species and to prevent introduction and  
14 spread of aquatic nuisance species, primarily through ballast water. The primary federal law  
15 regulating ballast water discharges, the act calls primarily for voluntary ballast water exchange by  
16 vessels entering the United States after operating outside of the Exclusive Economic Zone.

17 The authority to regulate ballast water discharges in the United States has recently shifted to include  
18 the USEPA in addition to the U.S. Coast Guard. Since February 2009, the USEPA must regulate ballast  
19 water, and other discharges incidental to normal vessel operations, under the CWA. U.S. Coast Guard  
20 regulations, developed under authority of the revised and reauthorized act, also require ballast  
21 water management (i.e., ballast water exchange) for vessels entering United States waters from  
22 outside of the 200-nautical mile Exclusive Economic Zone of the United States. Vessels that  
23 experience undue delay are exempted from the ballast water management requirements. The act  
24 also authorized funding for research on aquatic nuisance species prevention and control in the Bay-  
25 Delta, the Pacific Coast, and other areas of the United States.

## 26 **11.2.2 State Plans, Policies, and Regulations**

### 27 **11.2.2.1 California Endangered Species Act**

28 CESA (Fish and Game Code Sections 2050 to 2089) establishes various requirements and  
29 protections regarding species listed as threatened or endangered under state law. California's Fish  
30 and Game Commission is responsible for maintaining lists of threatened and endangered species  
31 under CESA. CESA prohibits the "take" of listed and candidate (petitioned to be listed) species (Fish  
32 and Game Code Section 2080). In accordance with Section 2081 of the California Fish and Game  
33 Code, a permit from CDFW is required for projects "that could result in the incidental take of a  
34 wildlife species state-listed as threatened or endangered". "Take" under California law means to  
35 "...hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch capture, or kill..." (Fish and  
36 Game Code Section 86). The state definition does not include "harm" or "harass," as the federal  
37 definition does. As a result, the threshold for take under CESA is typically higher than that under the  
38 federal ESA. Therefore, the CESA requirements would be met by complying with federal ESA  
39 requirements, as is the case with the SWP complying with the USFWS and NMFS BiOps.

### 11.2.2.2 Fully Protected Species under the California Fish and Game Code

Protection of fully protected species is described in four sections of the Fish and Game Code that lists 37 fully protected species (Fish and Game Code Sections 3511, 4700, 5050, and 5515). These statutes prohibit take or possession of fully protected species at any time. CDFW is unable to authorize incidental take of fully protected species when activities are proposed in areas inhabited by these species, except pursuant to an approved Natural Community Conservation Plan. Fish and Game Code section 5515 provides that the following fish species are fully protected:

- (1) Colorado River squawfish (*Ptychocheilus lucius*).
- (2) Thicktail chub (*Gila crassicauda*).
- (3) Mohave chub (*Gila mohavensis*).
- (4) Lost River sucker (*Catostomus luxatus*).
- (5) Modoc sucker (*Catostomus microps*).
- (6) Shortnose sucker (*Chasmistes brevirostris*).
- (7) Humpback sucker (*Xyrauchen texanus*).
- (8) Owens River pupfish (*Cyprinodon radiosus*).
- (9) Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*).
- (10) Rough sculpin (*Cottus asperimus*).

### 11.2.2.3 California Fish and Game Code Section 1602 – Lake and Streambed Alteration Program

Diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by CDFW, pursuant to Section 1600 of the California Fish and Game Code. The regulatory definition of a stream is a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports wildlife, fish, or other aquatic life. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation. CDFW's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife.

### 11.2.2.4 The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act

Enacted in 1988, the Salmon, Steelhead Trout, and Anadromous Fisheries Program Act was implemented in response to reports that the natural production of salmon and steelhead in California had declined dramatically since the 1940s, primarily as a result of lost stream habitat on many streams in the State. The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act declares that it is the policy of the State of California to increase the State's salmon and steelhead resources, and directs CDFW to develop a plan and program that strives to double the salmon and steelhead resources (Fish and Game Code Section 6902[a]). It is also the policy of the State that existing natural salmon and steelhead habitat shall not be diminished further without offsetting the impacts of lost habitat (Fish and Game Code Section 6902[c]).

### 11.2.2.5 Marine Invasive Species Act

The Marine Invasive Species Act of 2003 (Assembly Bill 433) revised and expanded the Ballast Water Management for Control of Nonindigenous Species Act of 1999 to more effectively address the threat of nonindigenous species introductions. The law charged the California State Lands Commission with oversight of the State's program to prevent or minimize the introduction of nonindigenous species from commercial vessels. The Marine Invasive Species Act requires all vessels over 300 gross registered tons that arrive at a California port or location to have a ballast water management plan and ballast tank logbook specific to the vessel. A ballast water reporting form detailing the ballast water management practices must be submitted by each vessel upon departure from each port of call in California. Since July 2006, over 22,000 reporting forms have been submitted to the California State Lands Commission. To verify that vessels have submitted reporting forms, received forms are matched with arrival data from the State's Marine Exchanges (Falkner et al. 2009). The 2009 *Biennial Report on the California Marine Invasive Species Program* reports that rates with ballast water management requirements in California remained extremely high from mid-2006 to mid-2008; between about 85 and 98% of vessel-reported ballast water carried into California waters was managed through legal ballast water exchange and was in compliance with California law (Falkner et al. 2009).

### 11.2.2.6 Natural Community Conservation Planning Act

The Natural Community Conservation Planning Act (NCCPA) authorizes the NCCP Program, which is designed to promote conservation of natural communities at the ecosystem scale, while accommodating compatible land use. The NCCP Program is broader in its orientation and objectives than the CESA and ESA (California Department of Fish and Game 2010d). The ESA laws are designed to identify and protect individual species that have already significantly declined in number, while the primary objective of the NCCP program is to conserve natural communities at the ecosystem level while accommodating compatible land use (California Department of Fish and Game 2010d). The program seeks to anticipate and prevent the controversies and gridlock caused by species' listings by focusing on the long-term stability of wildlife and plant communities and including key interests in the process (California Department of Fish and Game 2010d). Working with landowners, environmental organizations, and other interested parties, a local agency oversees the numerous activities that compose the development of a conservation plan. CDFW and USFWS provide the necessary support, direction, and guidance to NCCP participants (California Department of Fish and Game 2010d).

### 11.2.2.7 California Aquatic Invasive Species Management Plan

The California Aquatic Invasive Species Management Plan State surveys indicate that at least 607 species of aquatic invasive species can be found in California's estuarine waters. These invaders cause major impacts: disrupting agriculture, shipping, water delivery, recreational and commercial fishing; undermining levees, docks, and environmental restoration activities; impeding navigation and enjoyment of the State's waterways; and damaging native habitats and the species that depend on them. As the ease of transporting organisms across the Americas and around the globe has increased, so has the rate of aquatic species introductions (California Department of Fish and Game 2008c). The California Aquatic Invasive Species Management Plan meets federal requirements to develop statewide nonindigenous aquatic nuisance species management plans under Section 1204 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The Plan identifies the

1 steps that need to be taken to minimize the harmful ecological, economic, and human health impacts  
 2 of aquatic invasive species in California by providing a comprehensive, coordinated effort to prevent  
 3 new invasions, minimize impacts from established aquatic invasive species, and establish priorities  
 4 for action statewide.

### 5 **11.2.2.8 Central Valley Flood Protection Board**

6 The Central Valley Flood Protection Board (CVFPB) (formerly the California Reclamation Board) of  
 7 the State of California regulates the modification and construction of levees and floodways in the  
 8 Central Valley defined as part of the Sacramento Valley and San Joaquin Valley flood control  
 9 projects. Rules promulgated in Title 23 of the California Code of Regulations (CCR) (Title 23, Division  
 10 1, Article 8 [Sections 111–137]) regulate the modification and construction of levees to ensure  
 11 public safety. The rules state that existing levees may not be excavated or left partially excavated  
 12 during the flood season, which is generally November 1–April 15 for the Plan Area levees.

13 According to California Government Code Sections 65302.9 and 65860.1, every jurisdiction located  
 14 within the Sacramento–San Joaquin Valley is required to update its General Plan and Zoning  
 15 Ordinance in a manner consistent with the Central Valley Flood Protection Plan (CVFPP) In addition,  
 16 the locations of the state and local flood management facilities, locations of flood hazard zones, and  
 17 the properties located in these areas must be mapped and consistent with the CVFPP.

### 18 **11.2.2.9 Sacramento–San Joaquin Delta Reform Act of 2009**

19 In late 2009, the California Legislature enacted a package of related water bills that included the  
 20 Sacramento–San Joaquin Delta Reform Act of 2009 (Delta Reform Act). One of the many objectives of  
 21 the Delta Reform Act is to “[r]estore the Delta ecosystem, including its fisheries and wildlife, as the  
 22 heart of a healthy estuary and wetland ecosystem.” The Delta Reform Act also addressed issues that  
 23 should be considered in the development of the EIR alternatives if, under California Water Code  
 24 section 85320, the BDCP is to be included by operation of law within the Delta Plan prepared by the  
 25 Delta Stewardship Council (DSC). To qualify for inclusion in the BDCP under this process, the BDCP  
 26 must take the form of an NCCP under California law and a HCP under federal law. The EIR for the  
 27 BDCP must address, among other topics, “[t]he potential effects on migratory fish and aquatic  
 28 resources.”

## 29 **11.2.3 Regional and Local Plans, Policies, and Regulations**

### 30 **11.2.3.1 CALFED Bay-Delta Program**

31 The CALFED Program is a collaborative effort of over 20 federal and state agencies focusing on  
 32 restoring the ecological health of the Bay-Delta while ensuring water quality improvements and  
 33 water supply reliability to all users of the Bay-Delta water resources. The CALFED Program includes  
 34 a range of balanced actions that are used in a comprehensive, multi-agency approach to managing  
 35 Bay-Delta resources (California Department of Fish and Game 2008b). The objectives of the CALFED  
 36 Program are listed below.

- 37 • Provide good water quality for all beneficial uses
- 38 • Improve and increase aquatic and terrestrial habitats and improve ecological functions in the
- 39 Bay-Delta to support sustainable populations of diverse and valuable plant and animal species

- 1 • Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial
- 2 uses dependent on the Bay-Delta system
- 3 • Reduce the risk to land use and associated economic activities, water supply, infrastructure, and
- 4 the ecosystem from catastrophic breaching of Delta levees

5 The program objectives have been implemented among numerous CALFED Program elements since  
6 the CALFED Program Record of Decision was issued in 2000 (CALFED Bay-Delta Program 2000c).

### 7 **11.2.3.2 CALFED Levee System Integrity Program**

8 CALFED's Levee System Integrity Program provides long-term protection for vast resources in the  
9 Delta by maintaining and improving the integrity of the estuary's extensive levee system.

### 10 **11.2.3.3 Environmental Water Account**

11 The CALFED Program Record of Decision (2000c) identified an Environmental Water Account  
12 (EWA) as one element of its overall strategy for meeting the goals of the CALFED Program (Bureau  
13 of Reclamation 2008b). The EWA was a cooperative management program to protect the fish of the  
14 Bay-Delta through environmentally beneficial changes in SWP and CVP operations at no  
15 uncompensated water cost to SWP and CVP water users. The EWA consisted of two primary  
16 elements: (1) assisting in protecting and restoring at-risk native fish species; and (2) increasing  
17 water supply reliability for SWP and CVP water service contractors by reducing uncertainty  
18 associated with fish protective actions. To accomplish these two elements, the EWA helped  
19 protect/restore at-risk fish by primarily curtailing pumping at the Banks and Jones pumping plants,  
20 and helped ensure water supply reliability by purchasing water from willing sellers used to replace  
21 contract water supplies not diverted from the Delta during pumping curtailments (U.S. Bureau of  
22 Reclamation 2010). The EWA was implemented until 2007.

### 23 **11.2.3.4 CALFED Ecosystem Restoration Program Conservation Strategy**

24 The Ecosystem Restoration Program (ERP) is the principal CALFED Program component designed to  
25 restore the ecological health of the Bay-Delta ecosystem. The approach of the ERP is to restore or  
26 mimic ecological processes and to increase and improve aquatic and terrestrial habitats to support  
27 stable, self-sustaining populations of diverse and valuable species (California Department of Fish  
28 and Game 2008b). Stage 1 of the ERP Conservation Strategy is being used to facilitate coordination  
29 and integration of actions, not only within CALFED, but among all resource planning, conservation,  
30 and management decisions affecting the Delta, Suisun Marsh, and San Francisco Bay planning areas  
31 (California Department of Fish and Game 2008b). The Conservation Strategy is essentially the  
32 guidance to plan activities for Stage 2 of the ERP concerning the Delta and Suisun Marsh, and has  
33 evolved into the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP).

### 34 **CALFED End of Stage 1 Report/Stage 2 Planning**

35 The End of Stage 1 Evaluation, produced by the CALFED Program staff (CALFED 2007), qualitatively  
36 assessed the effectiveness of actions that met program objectives during Stage 1 of the ERP and if  
37 these actions will allow the Program to meet future objectives (CALFED 2007). This assessment will  
38 be used to assist with Stage 2 planning.

## 1 **Delta Regional Ecosystem Restoration Implementation Plan**

2 The original intent of the ERP was to develop multiple implementation plans, including one for the  
3 Delta. The DRERIP serves to refine the planning foundation specific to the Delta, refine existing  
4 Delta-specific restoration actions and provide Delta-specific implementation guidance, program  
5 tracking, performance evaluation and adaptive management feedback.

6 DRERIP implements adaptive management by incorporating scientific evaluation of restoration  
7 actions in light of the current state of knowledge and restoration projects implemented to date.  
8 The DRERIP science input process is divided into four phases: (1) process design; (2) development  
9 of species life history models and ecosystem element conceptual models; (3) development and  
10 evaluation of proposed ERP actions; and (4) analysis of the feasibility and prioritization of the  
11 actions.

### 12 **11.2.3.5 CALFED Integrated Storage Investigation**

13 DWR and Reclamation are conducting planning and feasibility studies to evaluate the five potential  
14 surface storage projects (e.g., the In-Delta Storage Project and Los Vaqueros Reservoir Expansion)  
15 identified in the CALFED Program Record of Decision. The goal of the storage investigation is to  
16 increase water supply reliability, improve water quality, and support ecosystem restoration through  
17 expanded storage capacity and increased operational flexibility. Additional surface storage will  
18 provide flexibility to the State's water management system, which can be operated to contribute to  
19 the long-term sustainability of the Delta ecosystem, maintaining water quality and supply reliability,  
20 and preventing and planning for catastrophic failure of the Delta levee system. With additional  
21 storage capacity and integrated operations, water diversion and deliveries also can be timed in ways  
22 that will allow for better response to the effects of earthquakes, floods, and climate change. The Los  
23 Vaqueros Reservoir Expansion project is now proceeding with construction  
24 (<http://www.ccwater.com/lvexpansion/index.asp>). The other projects are in various stages of  
25 investigation (<http://www.water.ca.gov/storage/index.cfm>).

### 26 **11.2.3.6 Interagency Ecological Program Pelagic Organism Decline Studies** 27 **and the CALFED State of the Bay-Delta Science Report**

28 Since observation of the POD, numerous studies have been conducted to help understand and  
29 describe the processes, mechanisms, and interrelationships of the Delta ecosystem. An initial  
30 synthesis of this information has been compiled in two documents: the *Pelagic Fish Action Plan*  
31 (California Department of Water Resources and California Department of Fish and Wildlife 2007)  
32 and the *POD Synthesis Report* (Baxter et al. 2008). The first document includes actions that address  
33 the three possible categories of courses of the ecosystem decline being investigated by the IEP POD  
34 Team: water project operations, contaminants, and invasive species. The *State of Bay-Delta Science*  
35 *2008* report is the CALFED Science Program's first extensive effort at compiling, synthesizing, and  
36 communicating the current scientific understanding of the San Francisco Bay Estuary and the Delta  
37 ecosystems (CALFED Bay-Delta Program 2008). The POD team has continued studies and  
38 evaluation. Their most recent work plan and synthesis of results was released in December 2010  
39 (Baxter et al. 2010).

### 11.2.3.7 The Delta Plan

The Delta Stewardship Council (DSC) was created by SB 1X7, which made comprehensive changes to the governance of the Delta. The bill established that the Delta Stewardship Council has jurisdiction over land use projects in the Delta area. The DSC is composed of members who represent different parts of the State and offer diverse expertise in fields such as agriculture, science, the environment, and public service. Of the seven members, four are appointed by the Governor, one each by the Senate and Assembly, and the seventh is the chair of the Delta Protection Commission. In addition, they are advised by a 10-member board of nationally and internationally renowned scientists.

The mission of the DSC is to achieve coequal goals through development of a Delta Plan<sup>2</sup>. As stated in the California Water code, “Coequal goals’ means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place” (CA Water Code § 85054). The Delta Plan is a comprehensive, long-term management plan to achieve these goals for the Delta and it is anticipated to be one of the most complex and comprehensive planning efforts in the State’s history.

The Delta Plan generally covers five topic areas and goals: increased water supply reliability, restoration of the Delta ecosystem, improved water quality, reduced risks of flooding in the Delta, and protection and enhancement of the Delta. The DSC does not propose constructing, owning, or operating any facilities related to these five topic areas. Rather, the Delta Plan sets forth regulatory policies and recommendations that seek to influence the actions, activities, and projects of cities and counties and state, federal, regional, and local agencies toward meeting the goals in the five topic areas.

The DSC is in the process of finalizing and approving the Delta Plan. Five draft plans were developed between January and August 2011. The Fifth Staff Draft Delta Plan, released in August 2011, consists of 12 policies and 61 recommendations, as well as other background information. The Final Draft of the Delta Plan was released on November 30, 2012, and the Proposed Final Delta Plan was released May 16, 2013.

### 11.2.3.8 Long-Term Management Strategy for Dredged Materials in the Delta

The Long Term Management Strategy for Dredged Materials in the Delta improves operational efficiency and coordination of the collective and individual agency decision-making responsibilities resulting in approved dredging and dredged material management actions in the Delta and San Francisco Bay. Approved dredging and dredged material management actions will take place in a manner that protects and enhances Delta water quality, identifies appropriate opportunities for the beneficial reuse of Delta sediments for levee rehabilitation and ecosystem restoration, and establishes safe disposal for materials that cannot be reused.

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<sup>2</sup> Part 4 of the Sacramento–San Joaquin Delta Reform Act of 2009 describes the responsibilities of DSC with respect to the development of the Delta Plan

### 11.2.3.9 Assembly Bill 1200

Assembly Bill 1200 (2005) added Sections 139.2 and 139.4 to the California Water Code. These require DWR to evaluate the potential effects on water supplies derived from the Delta resulting from subsidence, earthquakes, floods, changes in precipitation, temperature, and ocean levels, and a combination of those effects.

### 11.2.3.10 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

The 1995 State Water Board WQCP is one component of the comprehensive management package for the protection of the Bay-Delta's beneficial uses. The 1995 WQCP includes objectives for salinity (from saltwater intrusion and agricultural drainage), water project operations (flows and diversions), and DO levels in the Delta. Additionally, the 1994 Bay-Delta Accord committed the SWP and CVP to a set of water quality objectives that were eventually incorporated by the State Water Board into Water Right Decision 1641 (D-1641) (State Water Resources Control Board and U.S. Environmental Agency 2000). Significant new elements of D-1641 compared to Decision 1485 include: (1) spring X2 salinity standards; (2) export to inflow ratios; (3) DCC gate closures; (4) San Joaquin River standards; and (5) a recognition of the CALFED Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards. In March 2000, the State Water Board revised D-1641 amending the SWP and CVP water rights. In effect, D-1641 obligates the SWP and CVP to comply with the 1995 WQCP standards for fish and wildlife protection, municipal and industrial water quality, agricultural water quality, and Suisun Marsh Salinity Control (National Marine Fisheries Service 2004).

The State Water Board has previously adopted WQCPs and policies to protect water quality and control water resources, which affect the beneficial uses of the Bay-Delta. The 1995 WQCP supersedes both the 1978 D-1485 WQCP for the Delta and Suisun Marsh, and the 1991 WQCP for salinity in the Bay-Delta. The State Water Board adopted a new Bay-Delta WQCP on December 13, 2006. However, the 2006 WQCP made only minor changes to the 1995 WQCP. For these reasons, Bay-Delta Plan objectives and the resultant SWP and CVP operations required to meet those objectives, are incorporated into the hydrologic modeling assumptions used to characterize SWP and CVP operations as part of this study's hydrologic analyses of impacts on fisheries and aquatic resources. The 2006 WQCP is currently undergoing an update and implementation comprehensive review through CEQA environmental documentation in a State Water Board Substitute Environmental Document. As part of this review the State Water Board may also consider information that is produced as part of the BDCP.

### 11.2.3.11 Strategic Workplan for Activities in the Bay-Delta

During July 2008, the State Water Board adopted the Strategic Workplan for Activities in the San Francisco Bay/Sacramento San Joaquin Delta Estuary, which describes actions the State Water Board, the Central Valley Water Board, and the San Francisco Bay Regional Water Quality Control Board (collectively, the Water Boards) will take to protect beneficial uses in the Bay-Delta. Workplan activities are intended to: (1) implement the Water Boards' core water quality responsibilities; (2) continue meeting prior Water Board commitments; (3) be responsive to priorities identified by the Governor and the Delta Vision Blue Ribbon Task Force; and (4) build on existing processes, such as the BDCP.

1 Workplan activities include a suite of actions and are divided into nine broad elements that address:  
 2 (1) water quality and contaminant control; (2) south Delta salinity and San Joaquin River flow  
 3 objectives; (3) Suisun Marsh salinity objectives; (4) the BDCP, water rights, and other requirements  
 4 to protect fish and wildlife beneficial uses; (5) SWP and CVP Delta diversion operations that are  
 5 reasonable, beneficial, and protect the public trust; (6) water right compliance and enforcement to  
 6 ensure adequate flows to meet water quality objectives; (7) actions to address water use efficiency  
 7 for urban and agricultural water users; (8) development and implementation of a comprehensive  
 8 monitoring program in the Delta; and (9) other actions (State Water Resources Control Board et al.  
 9 2008).

### 10 **11.2.3.12 Delta Vision Strategic Plan**

11 The intent of the Delta Vision process is to identify a strategy for managing the Delta as a sustainable  
 12 ecosystem that will continue to support environmental and economic functions critical to the people  
 13 of California (Governor’s Delta Blue Ribbon Task Force 2008). The Governor’s Delta Vision Blue  
 14 Ribbon Task Force, a governor-appointed panel, is charged with developing recommendations on  
 15 priority actions that should be taken to achieve a sustainable Delta in the long-term (California  
 16 Department of Fish and Game 2008b). The Delta Vision has a broader focus than the ERP, and the  
 17 Governor’s Delta Blue Ribbon Task Force will issue recommendations that address the full array of  
 18 natural resources, infrastructure, land use, and governance issues necessary to achieve a sustainable  
 19 Delta. The Delta Vision is based on a growing consensus that: (1) environmental conditions and the  
 20 current water conveyance configuration of the Delta are not sustainable for environmental and  
 21 economic purposes; (2) current land and water uses and related services dependent on the Delta are  
 22 not sustainable based on current management practices and regulatory requirements; (3) major  
 23 “drivers of change” (e.g., seismic events, land subsidence, sea level rise, regional climate change, and  
 24 urbanization) will affect the Delta in the future; (4) the current fragmented and complex governance  
 25 systems within the Delta are not conducive to effective management of the Delta in light of these  
 26 threats; and (5) failure to address these challenges and threats could result in significant  
 27 environmental and economic consequences.

### 28 **11.2.3.13 Local Habitat Conservation Plans and Natural Community 29 Conservation Plans in the Delta**

30 Regional HCPs establish a coordinated process for permitting and mitigating the incidental take of  
 31 federal and state special-status species. This process creates an alternative to the current project-by-  
 32 project approach. Rather than individually surveying, negotiating, and securing mitigation and  
 33 permit coverage, project proponents typically receive an endangered species permit by paying a fee  
 34 and/or dedicating land and performing limited surveys and avoidance measures.

35 Within the Delta, several local or regional HCPs and/or NCCPs have been developed, and are  
 36 described below.

- 37 • ***CALFED Multi-Species Conservation Strategy*** – The MSCS identifies a process for development  
 38 of Action Specific Implementation Plans to be prepared for each CALFED action or groups of  
 39 actions as they are proposed for implementation. These plans are designed to provide the  
 40 information necessary to initiate project-level compliance with the federal ESA, CESA, and  
 41 NCCPA (CALFED Bay-Delta Program 2000b).
- 42 • ***East Contra Costa County HCP/NCCP*** – This approved HCP/NCCP was developed partially to  
 43 address indirect and cumulative effects on terrestrial species from development supported by

1 increases in water supply provided by Contra Costa Water District. The HCP/NCCP permit area  
 2 is primarily outside of the statutory Delta, with the exception of the Dutch Slough/Big Break  
 3 area, lower Marsh Creek, and lower Kellogg Creek. Investments in land acquisition and habitat  
 4 improvements are also focused outside of the statutory Delta. Fish species, including salmonids,  
 5 were not covered in the HCP/NCCP. Impacts on fisheries are addressed through separate  
 6 consultation and permitting (California Department of Fish and Game 2008b).

- 7 • **Yolo County HCP/NCCP** – This county-wide HCP/NCCP will provide for the conservation of  
 8 between 70 to 80 species in five habitat types: wetland, riparian, oak woodland, grassland, and  
 9 agriculture. No aquatic species are being addressed in this HCP; project-specific mitigation will  
 10 be developed for projects affecting aquatic resources (California Department of Fish and Game  
 11 2008b). Draft environmental documentation is currently under development (Yolo Natural  
 12 Heritage Foundation 2010).
- 13 • **Solano Multispecies HCP** – The Solano Multispecies HCP aims to address species conservation  
 14 in conjunction with urban development and flood control/infrastructure improvement  
 15 activities. Covered species include federally and state-listed fish species and other species of  
 16 concern. The geographic scope includes lands within the statutory Delta. The administrative  
 17 draft of the HCP was released in 2009 (Solano County Water Agency 2009).
- 18 • **San Joaquin County Multi-Species Conservation Plan** – This approved plan was developed to  
 19 provide guidelines for converting open space to other land uses, preserving agriculture, and  
 20 protecting species. The geographic scope includes lands within the statutory Delta (California  
 21 Department of Fish and Game 2008b).

#### 22 **11.2.3.14 Suisun Marsh Charter and Habitat Management, Preservation, 23 and Restoration Plan**

24 Agencies with primary responsibility for actions in Suisun Marsh formed a Charter Group to develop  
 25 a regional plan for Suisun Marsh (i.e., the *Suisun Marsh Habitat Management, Preservation, and  
 26 Restoration Plan*) that would guide ongoing operations in managed wetlands, and protect and  
 27 enhance Pacific Flyway and existing wildlife values, endangered species, and water project supply  
 28 quality. Principal agencies include USFWS, NMFS, Reclamation, CDFW, DWR, and the California Bay-  
 29 Delta Authority. Because Suisun Marsh includes private lands, the Suisun Resource Conservation  
 30 District also serves on the Charter Group to represent the interests of private landowners. The  
 31 Charter Group has also consulted other participating agencies, including the San Francisco Bay  
 32 Conservation and Development Commission (BCDC), U.S. Geological Survey, USACE, San Francisco  
 33 Bay-Delta Science Consortium, and the San Francisco Bay Water Board, in developing the Suisun  
 34 Marsh Plan. The Bureau of Reclamation, USFWS and CDFW issued a Final EIS/EIR for this plan in  
 35 December 2011. That plan recognizes its relationship to the BDCP process including the mutual  
 36 objective of habitat protection and restoration for many of the same species. Similarly, the BDCP  
 37 EIR/EIS recognizes the same relationship.

#### 38 **11.2.3.15 Regional Real-Time Decision Making and Information Sharing 39 Water Operations Management Team**

40 The Water Operations Management Team (WOMT) is comprised of senior representatives from  
 41 CDFW, USFWS, NMFS, DWR and Reclamation. The recommendations of the technical groups, along  
 42 with summaries of supporting information are conveyed to WOMT. The team considers the

1 recommendations of the technical groups, water supply costs and other factors and then provides  
2 DWR and Reclamation with appropriate operations guidance (CDFW no date).

3 WOMET has several technical teams that meet on a recurring basis. The technical teams analyze data  
4 and propose operation actions. A technical team can be associated with endangered species (delta  
5 smelt and winter-run Chinook salmon), real-time fish monitoring, or be a temporary workgroup  
6 formed to address a particular operation issue. (California Department of Water Resources 2013).

## 7 **Fisheries and Operations Technical Teams**

### 8 **Delta Operations for Salmon and Sturgeon (DOSS)**

9 The Delta Operations for Salmon and Sturgeon group is a technical advisory team that provides  
10 recommendations to Water Operation Management Team and NMFS on measures to reduce adverse  
11 effects of Delta operation of the CVP and SWP to salmonids and green sturgeon. The DOSS group  
12 shall also provide a coordinating function for the other technical working groups, to assure that  
13 relevant information from all technical groups is considered in actions. The DOSS group is  
14 comprised of biologists, hydrologists, and other staff with relevant expertise from Reclamation,  
15 DWR, CDFW, USFWS, and NMFS (NMFS 2013).

### 16 **Smelt Working Group**

17 The Smelt Working Group (SWG) evaluates biological and technical issues regarding delta smelt and  
18 longfin smelt and develops recommendations for consideration by USFWS. Since the longfin smelt  
19 became a state-listed species in 2009, the SWG has also developed recommendations for CDFW to  
20 minimize adverse effects on longfin smelt. The SWG consists of representatives from USFWS, CDFW,  
21 DWR, USEPA, and Reclamation. USFWS chairs the group, and members are assigned by each agency.

22 The SWG compiles and interprets the latest near real-time information regarding federally and  
23 state-listed smelt, such as stages of development, distribution, and salvage. After evaluating  
24 available information, and if they agree that a protection action is warranted, the SWG will submit  
25 their recommendations in writing to USFWS and CDFW. The SWG may meet at any time at the  
26 request of USFWS, but generally meets weekly during December through June, when smelt salvage  
27 at Jones and Banks pumping plants has occurred historically. However, the Delta Smelt Risk  
28 Assessment Matrix and Longfin Smelt Flow Measures (see below) outline the conditions when the  
29 SWG will convene to evaluate the necessity of protective actions and provide USFWS with  
30 recommendations. Further, with the State listing of longfin smelt, the group will also convene based  
31 on longfin smelt salvage history at the request of CDFW. The USFWS maintains a public record of  
32 SWG recommendations and its subsequent determinations on its website  
33 (<http://www.fws.gov/sfbaydelta/ocap/>).

### 34 **Delta Smelt Risk Assessment Matrix**

35 The SWG employs a Delta Smelt Risk Assessment Matrix (DSRAM) to assist in evaluating the need  
36 for operational modifications of SWP and CVP to protect delta smelt. This is a product and tool of the  
37 SWG, and will be modified by the SWG with the approval of USFWS, in consultation with  
38 Reclamation, DWR and CDFW, as new knowledge becomes available. The currently approved  
39 DSRAM is provided in Attachment A of Reclamation's 2008 long-term CVP/SWP Operation BA. If an  
40 action is taken, the SWG will follow up on the action to attempt to ascertain its effectiveness. The

1 ultimate decision-making authority rests with USFWS. An assessment of effectiveness is attached to  
2 the notes from the SWG's discussion concerning the action.

### 3 ***Longfin Smelt Risk Assessment Matrix***

4 As described above for delta smelt, the SWG employs a Longfin Smelt Risk Assessment Matrix to  
5 assist in evaluating the need for operational modifications of the SWP and CVP to protect longfin  
6 smelt during the December through May adult longfin smelt migration and spawning period, as well  
7 as the January through July period to protect larval and juvenile longfin smelt (California Fish and  
8 Game Commission 2008).

### 9 **Sacramento River Temperature Task Group**

10 The Sacramento River Temperature Task Group (SRTTG) is a multiagency group formed pursuant to  
11 State Water Resources Control Board (SWRCB) Water Rights Orders 90-5 and 91-1, to assist with  
12 improving and stabilizing Chinook population in the Sacramento River. Annually, Reclamation  
13 develops temperature operation plans for the Shasta and Trinity divisions of the CVP. These plans  
14 consider impacts on winter-run and other races of Chinook salmon, and associated project  
15 operations. The SRTTG meets initially in the spring to discuss biological, hydrologic, and operational  
16 information, objectives, and alternative operations plans for temperature control. Once the SRTTG  
17 has recommended an operation plan for temperature control, Reclamation then submits a report to  
18 the SWRCB, generally on or before June 1st each year. (NMFS 2013)

19 After implementation of the operation plan, the SRTTG may perform additional studies and  
20 commonly holds meetings as needed typically monthly through the summer and into fall. To develop  
21 revisions based on updated biological data, reservoir temperature profiles and operations data.  
22 Updated plans may be needed for summer operations protecting winter-run Chinook salmon, or in  
23 fall for fall-run Chinook salmon spawning season. If there are any changes in the plan, Reclamation  
24 submits a supplemental report to SWRCB. (NMFS 2013)

### 25 **Clear Creek Technical Working Group**

26 Since 1995, CVPIA and later CALFED have undertaken extensive habitat and flow restoration in  
27 Clear Creek. The restoration has increased stocks of fall Chinook and re-established populations of  
28 spring Chinook and steelhead. The Clear Creek Technical Team (CCTT) has been working since 1996  
29 to facilitate implementation of CVPIA anadromous salmonid restoration actions. Members include  
30 Whiskeytown National Recreation Area, NMFS, USFWS, Reclamation, Bureau of Land Management,  
31 CDFW, DWR, RWQCB, Western Shasta Resource Conservation District, Point Reyes Bird Observatory  
32 and several consultant groups. Team attendance has varied over the years depending on what topics  
33 are being covered in the meetings. The majority of the topics have involved physical habitat  
34 restoration funded by CVPIA and CALFED (Brown 2011).

35 The objectives of the Clear Creek working group are as follows:

- 36 ● Encourage spring-run movement to upstream Clear Creek habitat for spawning.
- 37 ● Minimize project effects by enhancing and maintain previously degraded spawning habitat for  
38 spring-run and CV steelhead.
- 39 ● Enhance and maintain previously degraded spawning habitat for spring-run and CV steelhead.

- 1 • Reduce adverse impacts of project operations on water temperature for listed salmonids in the  
2 Sacramento River.
- 3 • Reduce thermal stress to over-summering steelhead and spring-run during holding, spawning,  
4 and embryo incubation.
- 5 • Decrease risk to Clear Creek spring-run and CV steelhead population through improved flow  
6 management designed to implement state-of-the-art scientific analysis on habitat suitability.  
7 (Brown 2011)

### 8 **Stanislaus Operations Group**

9 The NMFS Biological Opinion (2011) calls for Reclamation to create a Stanislaus Operations Group  
10 to provide a forum for real-time operational flexibility and implementation of the alternative actions  
11 defined in the RPA. This group provides direction and oversight to ensure that the East Side Division  
12 actions are implemented, monitored for effectiveness and evaluated. Reclamation, in coordination  
13 with SOG, shall submit an annual summary of the status of these actions. Members of this group are  
14 from NMFS, Bureau of Reclamation, USFWS, CDFW, DWR, and SRCB (NMFS 2012). Also provide  
15 technical advice to WOMT.

### 16 **American River Group**

17 The American River Group conducts discussion regarding the biological and operational status of  
18 the lower American River, and provides information and formulates recommendations for the  
19 protection of fisheries and other instream resources. The group also provides input regarding  
20 operation of Folsom and Nimbus dams as part of the Central Valley Project (Water Forum 2007).  
21 The objectives for the American River as outlined by NMFS RPA Actions are as follows (Delta Council  
22 2010):

- 23 • Provide minimum flows for all steelhead life stages.
- 24 • Maintain suitable temperatures to support over-summer rearing of juvenile steelhead in the  
25 lower American River.
- 26 • Reduce stranding and isolation of juvenile steelhead through ramping protocol.
- 27 • Reclamation and DWR shall participate in the design, implementation, and funding of the  
28 comprehensive CV steelhead monitoring program.

### 29 **Other Groups**

#### 30 **CALFED Operations and Subgroups**

31 The CALFED “Ops Group” consists of the project agencies, the fishery agencies, State Water Board  
32 staff, and the USEPA. The CALFED Ops Group generally meets 11 times a year in a public setting so  
33 that the agencies can inform each other and stakeholders about current operations of the SWP and  
34 CVP, implementation of the CVPIA, ESA, and CESA, and additional actions to contribute to the  
35 conservation and protection of federally and state-listed species. The CALFED Ops Group held its  
36 first public meeting in January 1995, and during the next 6 years, the group developed and refined  
37 its process. The CALFED Ops Group has been recognized within State Water Board D-1641, and  
38 elsewhere, as one forum for coordination on decisions incorporated into the Delta standards for  
39 protection of beneficial uses (e.g., export/import [E/I] ratios and some DCC gate closures). Several  
40 teams were established through the Ops Group process, as described below.

### 1 **Data Assessment Team**

2 The Data Assessment Team (DAT) consists of technical staff members from the project and fishery  
3 agencies, as well as stakeholders. The DAT meets frequently during fall, winter, and spring. The  
4 purpose of the meetings is to coordinate and disseminate information and data among agencies and  
5 stakeholders that is related to water project operations, hydrology, and fish surveys in the Delta.

### 6 **B2 Interagency Team**

7 The B2 Interagency Team consists of technical staff members from the project agencies. The team  
8 meets weekly to discuss implementation of Section 3406 (b)(2) of the CVPIA, which defines the  
9 dedication of CVP water supply for environmental purposes. It communicates with the Water  
10 Operations Management Team to ensure coordination with the other operational programs or  
11 resource-related aspects of project operations, including flow and temperature issues.

### 12 **Interagency Fish Passage Steering Committee**

13 On June 4, 2009, the NMFS issued its Biological Opinion and Conference Opinion on the Long-Term  
14 Operations of the Central Valley Project and State Water Project (NMFS BiOp). The NMFS BiOp  
15 included the requirement that Reclamation create the Interagency Fish Passage Steering Committee  
16 (IFPSC). The IFPSC's role is to provide oversight and technical, management, and policy direction for  
17 a Fish Passage Program. The RPA includes development of a Fish Passage Program to evaluate  
18 reintroduction of listed species upstream of Shasta, Folsom, and New Melones dams. Because the  
19 duration of the consultation covers more than two decades NMFS anticipates that long-term future  
20 events, including increased water demand and climate change, will increase the frequency of  
21 temperature related mortality. Substantial areas of higher elevation habitat exist above these dams  
22 and could provide a refuge for cold water fish in the face of climate change. The IFPSC consists of  
23 representatives from Reclamation, NMFS, FWS, CDFG, DWR, Forest Service, and an academic  
24 member from UC Davis. The near-term goal is to increase the geographic distribution and  
25 abundance of listed species. The long-term goal is to increase abundance, productivity, and spatial  
26 distribution, and to improve the life history and genetic diversity of the target species. (Interagency  
27 Fish Passage Steering Committee 2010).

## 28 **11.3 Environmental Consequences**

29 This section describes the environmental consequences of the proposed alternatives, including the  
30 potential direct (both temporary and permanent construction-related and permanent operations-  
31 related) and indirect effects, on fish and aquatic resources within the affected environment that  
32 would result from implementation of each alternative. An analysis of the impact of each of the  
33 alternatives on covered species and non-covered aquatic species of primary management concern is  
34 provided. Impacts are also discussed with respect to the geographic locations in which they occur.  
35 These locations vary by action and species and range from the immediate vicinity of specific  
36 construction activities to broad flow changes within the Delta Plan area or upstream tributaries such  
37 as the Trinity, Sacramento, Feather, San Joaquin, and Mokelumne, or Stanislaus rivers.

38 This analysis of environmental consequences is presented in the following subsections.

1 **11.3.1 Impact Mechanisms** provides a general discussion of the construction, operations and  
 2 maintenance activities and processes associated with each group of conservation measures, and the  
 3 associated stressors that could potentially affect fish and other aquatic species. These impact  
 4 mechanisms and stressors are associated with specific activities that are common to all or some of  
 5 the alternatives. Impact mechanisms for the following categories are presented separately:  
 6 construction and maintenance of water conveyance facilities (CM1) (Section 11.3.1.1); water  
 7 operations (CM1) (Section 11.3.1.2); restoration measures (CM2, CM4–CM7, and CM10) (Section  
 8 11.3.1.3); and other conservation measures (CM12–CM19 and CM22) (Section 11.3.1.4).

9 **11.3.2 Methods of Analysis** presents information on how the impacts of entrainment (Section  
 10 11.3.2.1); flow, passage, salinity, and turbidity (Section 11.3.2.2); biological stressors such as invasive  
 11 aquatic vegetation and fish predation (Section 11.3.2.3); contaminants (Section 11.3.2.4); and habitat  
 12 restoration (Section 11.3.2.5) were assessed.

13 **11.3.3 Determination of Adverse Effects** describes the criteria for determining if an impact is  
 14 adverse and/or significant.

15 **11.3.4 Effects and Mitigation Approaches** provides a full discussion of impacts and mitigation  
 16 approaches for each alternative. Impacts for each alternative are presented grouped by species, and  
 17 within the species subsections, impacts are grouped by construction and maintenance, water  
 18 operations and restoration. Where impacts are common to multiple alternatives, the reader is  
 19 referenced back to the first alternative where the impact is fully discussed. Mitigation approaches are  
 20 also identified and described for each identified significant impact. Impacts are described for all sub  
 21 areas listed in Section 11.1.1 and for all species listed in Section 11.1.3.

22 Only impacts that have or reasonably could be expected to have impacts on fish or the aquatic  
 23 environment are included in the analysis.

24 The key questions to be addressed in this analysis of impacts to fish and aquatic resources are:

- 25 1. Would implementation of the alternative cause or substantially contribute to a significant  
 26 adverse impact on fish and aquatic resources?
- 27 2. If so, is feasible mitigation available to reduce this impact to a level of insignificance or does the  
 28 implementation of another conservation measure(s) render this otherwise significant impact  
 29 insignificant?

30 The following table presents a summary of the impacts to fish and aquatic resources based on  
 31 impact mechanisms, location and potential impact. It also displays if those impacts are significant,  
 32 whether mitigation is available to reduce that impact, and under which alternatives each impact  
 33 would occur.

## 34 **11.3.1 Impact Mechanisms**

35 This section presents information on potential impacts from the following categories.

- 36 ● Construction and maintenance of water conveyance facilities (e.g., intakes, pipelines and  
 37 tunnels, barge unloading facilities)
- 38 ● Water operations
- 39 ● Restoration measures

- Other conservation measures

Table 11-3 presents an overview of the primary construction elements associated with the conservation measures associated with the BDCP alternatives, and the area where potential impacts would occur. Detailed descriptions of all conservation measures are provided in Chapter 3 of this EIR/EIS in Section 3.6, *Components of the Alternatives*. Appendix 3C contains construction assumptions for CM1 under all alternatives. These impact mechanisms are discussed in more detail in the subsequent subsections.

**Table 11-3. Main Construction Elements of BDCP Conservation Measures with Potential to Affect Aquatic Environments**

CM	Title	Construction Elements (Aquatic Only)	Area
1	Water Facilities and Operation	<ul style="list-style-type: none"> <li>• Clearing and grubbing/demolition on the river bank at each of the intake locations</li> <li>• Detour and levee reinforcement on the river bank at each of the intake locations</li> <li>• Sheet pile cell (coffer dam) at each of the intake locations on the river bank and in the river channel</li> <li>• Dewatering/unwatering of each coffer dam</li> <li>• Excavation and dredging at each of the intake locations on the river bank and in the river channel after the coffer dam is constructed</li> <li>• Foundation piles for each of the intakes on the river bank and channel after the coffer dam is constructed</li> <li>• Armor and restoration at each of the intake locations on the river bank and in the river channel after the coffer dam is constructed</li> <li>• Barge unloading facilities that would include clearing and grubbing (most likely limited to any riparian areas in the path of equipment used to construct the facilities as well as access for equipment and onloading and offloading supplies from the facilities), pile driving, construction of the dock on top of the piles, and ultimately dismantling of the dock and cutting off the piles</li> </ul>	North Delta South Delta East Delta
2	Yolo Bypass Fisheries Enhancement	<ul style="list-style-type: none"> <li>• Physical modifications to Fremont Weir and Yolo Bypass (e.g., new/modified fish ladders, new gated seasonal floodplain channel)</li> <li>• Fish screens at Yolo diversions</li> <li>• New/replaced Tule Canal and Toe Drain impoundment structures and agricultural crossings</li> <li>• Lisbon Weir improvements (e.g., fish gate)</li> <li>• Lower and upper Putah Creek improvements (e.g., realignments)</li> <li>• Fish barriers at Knights Landing Ridge Cut and Colusa Basin Drain</li> <li>• Physical and nonphysical barriers in Sacramento River (e.g., bubble curtains, log booms)</li> <li>• Levee improvements</li> <li>• Removal of berms and levees, and construction of berms and levees, re-working of agricultural and delivery channels)</li> <li>• Sacramento Weir improvements (could include a channel from Sacramento River to Sacramento Weir and from Sacramento Weir to Toe Drain)</li> </ul>	Yolo Bypass

CM	Title	Construction Elements (Aquatic Only)	Area
3	Natural Communities Protection and Restoration	<ul style="list-style-type: none"> <li>No construction is associated with this measure; therefore, it would not result in construction-related effects on covered fish species.</li> </ul>	NA
4	Tidal Natural Communities Restoration	<ul style="list-style-type: none"> <li>Restore and create channel networks; deepen/widen channels</li> <li>Removal and construction of levees and embankments</li> </ul>	Suisun Marsh Cache Slough East Delta West Delta South Delta
5	Seasonally Inundated Floodplain Restoration	<ul style="list-style-type: none"> <li>Set back, remove, and/or breach levees</li> <li>Removal of riprap and bank protection between set-back levees</li> <li>Modify channels</li> <li>Create floodway bypasses</li> </ul>	South Delta
6	Channel Margin Enhancement	<ul style="list-style-type: none"> <li>Removal of riprap from channel margins</li> <li>Modify or set back levees</li> <li>Installation of large woody material in levees</li> </ul>	North Delta East Delta South Delta
7	Riparian Natural Community Restoration	<ul style="list-style-type: none"> <li>Removal of riprap</li> <li>Modify levees and/or channel modification, including possible bench construction</li> <li>Installation of riparian plantings</li> </ul>	North Delta East Delta South Delta
8	Grassland Natural Community Restoration	<ul style="list-style-type: none"> <li>This conservation measure would not result in any effects on covered fish species because the aquatic habitat would not be affected.</li> </ul>	NA
9	Vernal Pool Complex Restoration	<ul style="list-style-type: none"> <li>Excavate or recontour historical vernal pools. Because vernal pools typically have no outlets to receiving waters used by covered fish, this conservation measure would not affect covered fish species.</li> </ul>	Yolo Bypass Cache Slough Suisun Marsh Suisun Bay South Delta
10	Nontidal Marsh Restoration	<ul style="list-style-type: none"> <li>Establish connectivity with existing waterways</li> <li>Grade to create wetland topography</li> </ul>	Yolo Bypass North Delta Cache Slough
11	Natural Communities Enhancement and Management	<ul style="list-style-type: none"> <li>This conservation measure would not result in any effects on covered fish species because the aquatic habitat would not be affected.</li> </ul>	NA
12	Methylmercury Management	<ul style="list-style-type: none"> <li>Perform site-specific characterization and monitoring to mitigate methylmercury production during construction and operations.</li> <li>No construction is associated with this measure; therefore, it would not result in construction-related effects on covered fish species. However, methylmercury and this conservation measure are discussed in the context of potentially disturbing sediment containing methylmercury during construction.</li> </ul>	Yolo Bypass Suisun Marsh Cache Slough East Delta West Delta South Delta

CM	Title	Construction Elements (Aquatic Only)	Area
13	Invasive Aquatic Vegetation Control	<ul style="list-style-type: none"> <li>No construction is associated with this measure; therefore, it would not result in construction-related effects on covered fish species.</li> </ul>	Plan Area
14	Stockton Deep Water Ship Channel Dissolved Oxygen Levels	<ul style="list-style-type: none"> <li>Possible construction of additional aeration facilities</li> </ul>	South Delta
15	Localized Reduction of Predatory Fishes	<ul style="list-style-type: none"> <li>Removal of unused potential predator-habitat structures (e.g., old piers and abandoned boats)</li> </ul>	North Delta South Delta East Delta
16	Nonphysical Fish Barriers	<ul style="list-style-type: none"> <li>Installation of nonphysical fish barriers (e.g., sounds light, or bubble barriers)</li> </ul>	South Delta North Delta Yolo Bypass East Delta
17	Illegal Harvest Reduction	<ul style="list-style-type: none"> <li>No construction is associated with this measure; therefore, it would not result in construction-related effects on covered fish species.</li> </ul>	NA
18	Conservation Hatcheries	<ul style="list-style-type: none"> <li>Possible bank and channel construction</li> </ul>	West Delta
19	Urban Stormwater Treatment	<ul style="list-style-type: none"> <li>Establish vegetative buffer strips</li> <li>Construct bioretention systems</li> </ul>	North Delta South Delta
20	Recreational Users Invasive Species Program	<ul style="list-style-type: none"> <li>No construction is associated with this measure; therefore, it would not result in construction-related effects on covered fish species.</li> </ul>	NA
21	Nonproject Diversions	<ul style="list-style-type: none"> <li>Removal/relocation of unscreened diversions</li> </ul>	Plan Area
22	Avoidance and Minimization Measures	<ul style="list-style-type: none"> <li>Incorporate measures into BDCP activities that will avoid or minimize direct take of covered species and minimize impacts to critical habitat or natural communities that provide habitat for covered species.</li> </ul>	NA

1

### 2 **11.3.1.1 Potential Impacts Resulting from Construction and Maintenance** 3 **of Water Conveyance Facilities**

4 All in-water construction activities is expected to be restricted to the period between June 1 and  
5 October 31, when the potential for fish and aquatic species of concern to be present would be at a  
6 minimum. Construction outside this period would only be allowed if authorized by relevant  
7 permitting agencies, and additional construction timing restrictions could also be imposed by these  
8 agencies, to protect specific species. The potential for exposure of covered fish species to these  
9 activities is determined by species and life stage, as shown in Table 11-4.

1 **Table 11-4. Life Stages of Covered Species Present in the North, East and South Delta Subregions during**  
 2 **the In-Water Construction Window (June 1–October 31)**

Fish Species	North Delta			East Delta			South Delta		
	Life Stage	Timing	Size <sup>a</sup>	Life Stage	Timing	Size	Life Stage	Timing	Size
Delta smelt	Adult	Jun	>2g	Adult	Jun	>2g	Adult	Jun	>2g
	Larva	Jun–Jul	<2g	Larva	Jun–Jul	<2g	Larva	Jun–Jul	<2g
Longfin smelt	Adult	Not Present	>2g	Adult	Not Present	>2g	Adult	Not Present	>2g
	Larva	Not Present	<2g	Larva	Not Present	<2g	Larva	Not Present	<2g
Central Valley steelhead	Adult	Jun–Oct Sep	>2g	Adult	Not Present	>2g	Adult	Not Present	>2g
	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g
Winter-run Chinook salmon	Adult	Jun–Jul	>2g	Adult	Not Present		Adult	Not Present	
	Juvenile	Aug–Oct	<2g, >2g	Juvenile	Not Present	<2, >2	Juvenile	Not Present	<2, >2
Spring-run Chinook salmon	Adult	Jun Jul– Aug	>2g	Adult	Not Present		Adult	Not Present	
	Juvenile	Jun	<2g, >2g	Juvenile	Jun	<2g, >2g	Juvenile	Jun	<2g, >2g
Late fall–run Chinook salmon	Adult	Oct	>2g	Adult	Not Present		Adult	Not Present	
	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g
Fall-run Chinook salmon	Adult	Aug–Oct Sep	>2g	Adult	Aug–Oct Sep	>2g	Adult	Aug–Oct Sep	>2g
	Juvenile	Jun	>2g	Juvenile	Jun	<2g, >2g	Juvenile	Jun	<2g, >2g
Splittail	Larva	Jun	<2g	Larva	Jun		Larva	Jun	<2g
	Juvenile	Jun–Jul	<2g	Juvenile	Jun–Jul		Juvenile	Jun–Jul	<2g
Green sturgeon	Adult	Jun–Oct	>2g	Adult	Jun–Oct	>2g	Adult	Jun–Oct	>2g
	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g
White sturgeon	Adult	Jun–Oct	>2g	Adult	Jun–Oct	>2g	Adult	Jun–Oct	>2g
	Larva	Jun	<2g	Larva	Jun	<2g	Larva	Jun	<2g
Pacific lamprey	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g	Juvenile	Jun–Oct	>2g
	Adult	Jun–Aug	>2g	Adult	Jun–Aug	>2g	Adult	Jun–Aug	>2g
River lamprey	Ammocoetes	Jun–Oct	>2g	Ammocoetes	Jun–Oct	>2g	Ammocoetes	Jun–Oct	>2g
	Adult	Sep–Oct	>2g	Adult	Sep–Oct	>2g	Adult	Sep–Oct	>2g
Macrophthalmia	Ammocoetes	Jan–Dec	>2g	Ammocoetes	Jan–Dec	>2g	Ammocoetes	Jan–Dec	>2g
	Macrophthalmia	Jun–Jul	>2g	Macrophthalmia	Jun–Jul	>2g	Macrophthalmia	Jun–Jul	>2g

Black =abundant Medium Gray=semi-abundant Light Gray=low abundance White=unsure if present

Source: California Department of Water Resources 2013.

<sup>a</sup> Size categories represent thresholds for assessing potential injury to fish from pile driving underwater noise (see "Underwater Noise").

3

4 **Intakes**

5 **Construction**

6 Intake structures would be constructed and operated along the Sacramento River. Elements of these  
 7 intakes that could affect the aquatic environment are described below.

8 The Sacramento River channel and bank would be affected by construction and operation of the  
 9 intakes. The location, dimensions, and construction footprints of the intakes considered are shown  
 10 in Table 11-5.

1 **Table 11-5. Dimensions of Potential North Delta Intakes and Associated Construction Footprints<sup>a</sup>**

North Delta Intake	Location (River Mile)	Length of Screened Intake (feet)	Total Structure Length—Intake & Transitions (feet)	Temporary and Permanent Cofferdam Area (acres)	Permanent Screened Intake Footprint (acres)	Dredge and Channel Reshaping Area (acres)
<b>East Alternatives</b>						
1	44	700–1,450	1,100–2,050	1.2–5.0	1.0–3.8	2.5–4.7
2	41	1,100–1,800	1,300–2,400	1.7–6.0	1.4–4.5	3.0–5.5
3	40	700–1,450	1,300–2,250	1.3–5.2	1.1–4.0	3.0–5.2
4	38	950–1,600	1,350–2,400	1.5–5.6	1.3–4.3	3.1–5.5
5	37	1,200–2,000	1,600–2,800	1.9–6.9	1.6–5.2	3.7–6.4
6	32	950–1,600	1,350–2,600	1.5–5.9	1.3–4.6	3.1–6.0
7	30	850–1,450	1,250–2,050	1.4–5.0	1.2–3.8	2.9–4.7
<b>West Alternatives Totals</b>						
W-1	44	1,200–2,000	1,800–2,800	2.0–6.9	1.7–5.2	4.1–6.4
W-2	41	1,350–2,300	1,750–3,100	2.1–7.8	1.8–5.9	4.0–7.1
W-3	39	1,100–1,800	1,700–2,800	1.9–6.5	1.6–5.0	3.9–6.4
W-4	37	1,100–1,800	1,500–2,600	1.8–6.3	1.5–4.8	3.4–6.0
W-5	36	850–1,450	1,250–2,250	1.4–5.2	1.2–4.0	2.9–5.2

<sup>a</sup> Individual estimates for each intake would be added in different combinations to estimate the total potential effects for the various alternatives.

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Constructing each of the intakes would involve installing a sheet-pile cofferdam in the river on the waterward edge of the on-bank intake structure (Figure 3-20) during the first construction season to isolate a majority of the in-water work area around each intake. Some clearing and grubbing at the construction site may be required prior to installing the sheet pile cofferdam, depending on site conditions (e.g., presence of vegetation or bank protection). Clearing and grubbing activities may include removing riprap, vegetation, and garbage from the levee or channel area, and channel dredging and reshaping, within the aquatic habitat, depending on the specific placement of the sheet piles and the existing conditions. Any dredging outside of the cofferdams would be isolated from the river within a silt curtain enclosure.

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Once the cofferdam is installed, the area within the cofferdam would be dewatered using pumps with screened intakes. To minimize fish exposure to construction activities, the cofferdams would be, to the extent practicable, cleared of fish before construction activities are initiated. Although fish would likely avoid the noise and activity of sheet pile installation, cofferdams have the potential to entrap some fish. While the number of fish affected is unknown, entrapment could include a few hundred fish (total of all species). When the water level in the work area dropped to a manageable level, entrapped fish would be captured and released to the river using a combination of beach seines, dip nets, and electrofishing equipment. Fish removal would result in handling stress and possibly in some physical injuries or incidental mortality.

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Fish removal activities from construction areas would be implemented according to 3B.8–*Fish Rescue and Salvage Plan* (see Appendix 3B, *Environmental Commitments*). The plan would be consistent with NMFS electrofishing guidelines (National Marine Fisheries Service 2000), identify

1 minimum qualifications for fish handling personnel, and include protective measures to minimize  
 2 harm to fish. Protective measures would include practices such as using knotless mesh netting that  
 3 is sufficiently fine to prevent the gilling of juvenile salmonids, limiting holding time, specifying  
 4 appropriate release locations, limiting the number of fish per unit volume in transfer containers, and  
 5 minimizing handling to limit the risk of injury during fish removal.

6 Following dewatering, work in the area behind the newly constructed cofferdam is no longer  
 7 considered in-water work. Work within the cofferdam (e.g., excavation and pile driving) would  
 8 proceed. Water pumped from the cofferdams would be treated (removing all sediment) and  
 9 returned to the river.

10 Constructing each of the intakes would take between 3.5 and 4.5 years. All intakes would be  
 11 constructed simultaneously, with in-water work anticipated to begin in June 2019. Each of the  
 12 cofferdams (one installed at each intake) also would be constructed simultaneously from June to  
 13 October 2019. Multiple vibratory pile drivers would likely be needed to construct each intake  
 14 cofferdam due to their size.

15 Activities associated with construction of the intakes that could affect aquatic resources are listed in  
 16 Table 11-6. The table shows the general location of the activity and its general type of impact. The  
 17 impacts are further described in Section 11.3.4, *Effects and Mitigation Approaches*.

18 **Table 11-6. Effects Associated with Construction of Intakes**

Activity	Location	Potential Impact
Installation of sheet pile for cofferdam	In-water	Water quality Noise Direct impact Loss of habitat
Foundation pile driving	Behind dewatered cofferdam	Noise
Dredging	Behind dewatered cofferdam	None
Dewatering	Discharge of treated water to river	Water quality
Fish rescue activities	Behind cofferdam	Direct impact
Dredging and channel shaping	Outside of cofferdam	Water quality Direct impact Change in habitat substrate
Bank and channel reinforcement/ protection	River bank and channel	Change in habitat substrate

19  
 20 **Maintenance**

21 The proposed intake facilities would require routine or periodic adjustment and tuning to ensure  
 22 that operations are managed consistent with design intentions. Facility maintenance is part of long-  
 23 term asset management and includes activities such as painting, cleaning, repairs, and other routine  
 24 tasks to ensure the facilities are operated in accordance with design standards after construction  
 25 and commissioning.

26 Routine visual inspection of the facilities would be conducted to monitor performance and prevent  
 27 mechanical and structural failures of project elements. Maintenance activities associated with river

1 intakes could include removal of sediments, debris, and biofouling materials. These maintenance  
2 actions could require suction dredging or mechanical excavation around intake structures;  
3 dewatering; or use of underwater diving crews, boom trucks or rubber wheel cranes, and raft- or  
4 barge-mounted equipment.

#### 5 ***Dewatering***

6 It is expected that all panels would require annual removal (at a minimum) for pressure washing.  
7 Additionally, individual intake bays would require dewatering (one pair at a time) for inspection  
8 and assessment of biofoul growth rates. Dewatering would be accomplished by closing off portals  
9 with prefabricated bulkheads.

#### 10 ***Underwater Diving***

11 Underwater diving crews may be used to examine intakes and remove any large debris buildup. A  
12 deliberate monitoring program would increase awareness of conditions compromising operational  
13 performance and basic function.

#### 14 ***Raft- and Barge-Mounted Equipment***

15 A small barge with rigs and leads could be used during maintenance activities to haul and remove  
16 debris from restoration areas and project facilities (e.g., after storm events). Should substantial  
17 debris become lodged at the leading edge or adjacent to the intake structure, removal of the material  
18 may require equipment and specialized labor. Although historically the in-river intake technology  
19 has not been a debris trap, there may be incidents where large debris deposits in the vicinity of the  
20 structure compromise its function. In the wake of heavy-to-extreme hydrologic events, inspections  
21 should be conducted to visually confirm debris presence or the lack thereof. If large debris is found  
22 to have accumulated, removal would require boom trucks or rubber wheel cranes, and possibly a  
23 small barge and crew to rig the leads to the debris.

#### 24 ***Dredging***

25 Sediment deposition is a problem that commonly plagues manmade infrastructure in natural  
26 waterways. It can bury intakes and either reduce intake capability to divert or force shutdowns  
27 completely until working conditions are restored. Attention to this issue during engineering and  
28 design can reduce or avert this problem. However, the dynamic riverine environment can be  
29 unpredictable, and sedimentation can inhibit function and operations. Typical maintenance  
30 activities associated with river intakes can include the following.

- 31 ● Suction dredging around intake structures using raft- or barge-mounted equipment and  
32 pumping sediment to a landside spoil area.
- 33 ● Mechanical excavation around intake structures using track-mounted equipment and clamshell  
34 dragline from the top deck.
- 35 ● Dewatering of intake/sedimentation basin/pumping plant bays to remove sediment buildup in  
36 conduits and channels using small front-end loading equipment and manual labor.

37 The planned operation of proposed intakes would help mitigate sediment deposition within the  
38 intake bays and conveyance conduits when turbidity in the river exceeds a certain threshold. The  
39 sediment removal systems would be designed to keep sedimentation channels and wet well bays

1 free of sediment buildup. It is expected that only extreme conditions would give cause for the  
2 activities listed above.

### 3 **Levee Maintenance**

4 Maintenance activities may include replacement of riprap necessary to protect the hydrodynamic  
5 conditions, restoration features, and conveyance features and facilities.

## 6 **Pipelines and Tunnels**

### 7 **Construction**

8 The BDCP alternatives would involve conveyance pipelines and tunnels in various configurations.  
9 Impacts on the aquatic environment associated with both pipelines and tunnels would be limited to  
10 surface water crossings. Surface waters would be crossed by siphon structures in most cases, while  
11 drilled tunnels would be used for crossing larger surface water bodies.

12 The tunnels would be drilled from portals that would provide access for equipment and materials.  
13 These portals are located in upland areas and would not affect the aquatic environment. The areas  
14 would be designed to minimize the potential for stormwater runoff to surface waters.

### 15 **Maintenance**

16 Maintenance of the conveyance pipelines is dependent on the materials of construction as  
17 summarized in Table 11-7.

18 **Table 11-7. Summary of Pipeline Maintenance Considerations**

Material and Conduit Configuration	Maintenance Considerations
Steel pipe	Maintenance and operation of an impressed current cathodic protection system. Periodic internal inspections and repair of cement mortar lining.
RCCP or RCP	Periodic internal inspections and repair of cement mortar lining at the joints. Periodic inspections of internal concrete. Repairs to concrete, as needed, including sealing cracks and repairing spalling to prevent exposure of steel.
CIP	Periodic inspections of internal concrete and joints. Repairs to concrete, as needed, including sealing cracks and repairing spalling to prevent exposure of steel.
All	Regular periodic operation of radial gates. Repairs as needed. Vent inspection and repairs. Regular inspections along the line for signs of leakage or erosion of soil cover.

CIP = cast-in-place.  
RCCP = reinforced concrete cylinder pressure pipe.  
RCP = reinforced concrete pipe.

19

## 1 **Barge Unloading Facilities**

2 Temporary barge unloading facilities would be necessary to provide access for equipment and  
3 materials to the construction sites. The barge unloading facilities would be constructed at some of  
4 the locations listed below, depending on alternative; these locations are shown in Mapbooks M3-1,  
5 M3-2, M3-3, and M3-4.

- 6 • State Route 160 west of Walnut Grove (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- 7 • Venice Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- 8 • Bacon Island (Alternatives 1A, 2A, 3, 4, 5, 6A, 7, 8, and 9).
- 9 • Woodward Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. Two barge facilities would be  
10 constructed at this location under Alternative 9).
- 11 • Victoria Island (Alternatives 1A, 2A, 3, 4, 5, 6A, 7, and 8).
- 12 • Tyler Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- 13 • Hog Island (Alternatives 1B, 2B, and 6B).
- 14 • Ryer Island (Alternatives 1C, 2C, and 6C).
- 15 • Brannan Island (Alternatives 1C, 2C, and 6C).
- 16 • Byron Tract on Italian Slough (Alternative 4).
- 17 • Bouldin Island on San Joaquin River (Alternative 4).
- 18 • Staten Island on South Mokelumne River (Alternative 4).
- 19 • Webb Tract (two barge facilities would be constructed on Webb Tract under Alternative 9—  
20 one at the northwest corner, and one on the eastern side).
- 21 • Upper Jones Tract (Alternative 9).
- 22 • Victoria Island (Alternative 9).

23 These temporary barge unloading facilities could consist of the landing approach over the levees  
24 and construction of a temporary dock to facilitate loading and unloading of the barges. The  
25 temporary docks would be supported by piles that would be driven in the river. The number and  
26 type of piles driven for each barge landing is unknown but could entail approximately 36, 24-inch  
27 diameter (type) piles per landing. The dimensions of the docks are anticipated to be approximately  
28 50 by 300 feet. Where feasible, floating or existing docks could be used to reduce the amount of in-  
29 water construction activities required to construct the unloading facilities.

30 At the barge unloading facilities, piles likely would need to be driven to secure the barges or support  
31 docks for the transit of equipment and material to and from the portal sites. Sediments could be  
32 disturbed by propeller wash or wakes from the vessels used for transport and landing of the barges.

33 Approximately 3,000 barge trips are projected to carry construction materials to the sites listed  
34 above. The landings would be in operation through construction activities at each associated portal  
35 (from 1 to 3 years, depending on which portals are serviced).

36 After construction serviced by a landing is completed, the dock would be removed, and the area of  
37 the landing would be restored to pre-construction conditions.

## 1 Bank and Channel Reinforcement/Protection

2 Rock protection would be installed along the river banks approximately 100 feet upstream and  
3 downstream, and along the front of the intakes to protect the intakes and to prevent bank and  
4 channel erosion. The intake structures and associated bank protection would permanently change  
5 existing substrates and local hydraulic conditions in the immediate vicinity of the intakes.

6 Intake pumping plants, sedimentation basins, and solids handling facilities for each intake would be  
7 constructed on the land side of the Sacramento River levees and, therefore, would not be considered  
8 in-water work. Stormwater best management practices (BMPs) would be installed to avoid or  
9 minimize the potential for sediment-laden runoff from entering surface waters.

## 10 Underwater Noise

11 Underwater noise can be generated by a variety of activities associated with the construction and  
12 operation of North Delta intakes and the barge landings, the most notable being pile driving.  
13 Cofferdam installation will be required to construct the intakes. DWR proposes to use a vibratory  
14 driver to install the sheet piles comprising the cofferdams to the extent that geologic conditions at  
15 the construction sites allow. Vibratory driving does not result in underwater sound great enough to  
16 injure fish. However, it is possible that some sheet piles will require impact driving due to as yet  
17 undetermined geologic conditions at the intake construction sites.

18 Research indicates that impact pile driving can result in injuries to fish if the peak sound pressure  
19 levels are high enough or the exposure is long enough. Dual interim criteria were developed to  
20 provide guidance for underwater sound levels protective of injury to fish. The dual thresholds for  
21 impact pile driving are (1) 206 decibels (dB) for the peak sound pressure level; and 187 dB for the  
22 cumulative sound exposure level ( $SEL_{cumulative}$ ) for fish larger than 2 grams, and 183 dB  $SEL_{cumulative}$   
23 for fish smaller than 2 grams. The  $SEL_{cumulative}$  threshold is based on the cumulative daily exposure of  
24 a fish to noise from sources that are discontinuous (i.e., noise that occurs only for about 8 to 12 hours  
25 in a day, with 12 to 16 hours between exposure). This assumes that the fish is able to recover from  
26 any effects during this 12 to 16 hour period. In addition, the exposures do not accumulate beyond  
27 the range (distance from the sound source) where the SEL is attenuated below 150 dB.

28 Based on underwater sound measurements collected during sheet pile installation with an impact  
29 pile driver, source sound levels (the level measured at 10 meters [33.3 feet] from the pile), could be  
30 as high as 205 dB maximum peak, and a single strike sound exposure level (SEL) of 180 dB  
31 (California Department of Transportation 2009). The peak sound level is not expected to exceed the  
32 interim criteria of 206 dB. The  $SEL_{cumulative}$  level is dependent on the source single-strike SEL and the  
33 number of pile strikes in a day. Figure 11-2 illustrates the attenuation of  $SEL_{cumulative}$  to the 187-dB  
34 and 183-dB interim criteria for a number of sheet pile driving scenarios ranging from 5 to 8,000  
35 strikes in a day. The specific number of piles that will be driven per day with an impact pile driver,  
36 and thus the number of pile strikes per day will depend on the geologic conditions at the  
37 construction sites. Using preliminary estimates for illustrative purposes, if eight sheet piles were  
38 impact driven in a day, and assuming a source sound level of 180 dB single-strike SEL and 500  
39 strikes per sheet pile (4,000 strikes in a day),  $SEL_{cumulative}$  levels would exceed the 183-dB  
40  $SEL_{cumulative}$  criterion (for fish smaller than 2 grams) out to a distance of about 3,280 feet from the  
41 pile being driven, and would exceed the 187-dB  $SEL_{cumulative}$  criterion (for fish larger than 2 grams)  
42 out to approximately 2,950 feet. For comparison, if only two sheet piles were impact driven in a day  
43 (1,000 strikes), the distance to the 187-dB  $SEL_{cumulative}$  criterion would be approximately 1,050 feet.

1 While these distances would extend across the entire river channel, the distance upstream and  
2 downstream would vary by construction location, as sound does not radiate around river bends. As  
3 a result, there would be limited overlap in the sound fields generated from pile driving at two intake  
4 locations simultaneously.

5 The cofferdams (the number of cofferdams varies from 1 to 5 by alternative) may be constructed  
6 during one in-water work window or construction may be spread across more than one window. In  
7 order to construct the cofferdams within one in-water work window, exceedance of these criteria  
8 over some distance of the river would likely be unavoidable if impact driving is required. No  
9 effective methods are available to attenuate sound from impact driving of sheet pile because the  
10 sheets need to be interlaced, and individual sheets cannot be isolated by sound attenuation devices  
11 (e.g., isolation casings or air bubble rings) as they are driven.

12 After the cofferdam is constructed and dewatered, foundation piles would be installed to support  
13 the intakes and pumping plant. The foundation piles would either be cast-in-drilled hole (CIDH)  
14 piles, which do not require pile driving (only drilling) or 24-inch-diameter steel pipe piles that are  
15 driven and then filled with concrete. It is anticipated that, if piles are driven, they would be primarily  
16 vibrated. However, as with the sheet pile, some of these foundation piles may require impact  
17 driving. Figure 11-3 illustrates the attenuation of the SEL<sub>cumulative</sub> level to the 183-dB and 187-dB  
18 interim criteria for a number of 24-inch pipe pile driving scenarios ranging from 5 to 8,000 strikes in  
19 a day. This figure represents the piles being driven in a dewatered cofferdam, which is estimated to  
20 attenuate sound transmittance to water by approximately 10 dB. With this 10 dB reduction, the  
21 source maximum peak level is estimated to be 193 dB, and the single-strike SEL level is estimated to  
22 be 167 dB based on data from other measured piles (California Department of Transportation  
23 2009).

24 Behind a cofferdam, a daily impact strike total of 4,000 strikes, for example, would result in the  
25 SEL<sub>cumulative</sub> level above 187 dB extending approximately 390 feet from the pile. Other than the 10 dB  
26 attenuation provided by the dewatered cofferdam, no other methods could be used to attenuate the  
27 sound further. In order to proceed with the construction, foundation piles could be driven at various  
28 times of the year, not only within the in-water work windows. In that event, the potential for  
29 covered fish to be exposed to increased sound levels is greater than that described for noise  
30 increases from impact sheet pile installation.

31 DWR anticipates that most or all of the barge landings will utilize floating docks, however it is  
32 possible that the contractors would use pile supported docks. For pile supported barge landings, up  
33 to 36 24-inch diameter pipe piles would be needed to support the temporary docks at each of the six  
34 landings. Although vibratory methods would be predominantly used to drive these piles, geological  
35 conditions at the sites are not known at this time, and some piles may require impact driving. The  
36 maximum peak source level for an impact-driven 24-inch pipe pile would be 203 dB based on data  
37 from other measured piles (California Department of Transportation 2009). This level is below the  
38 peak criterion of 206 dB. Figure 11-4 illustrates the attenuation of the SEL<sub>cumulative</sub> level to the 187-  
39 dB and 183-dB interim criteria for a number of 24-inch pipe pile driving scenarios ranging from 5 to  
40 8,000 strikes in a day. This figure represents the piles being driven in open water without  
41 attenuation devices. The source single-strike SEL level is estimated to be 177 dB based on data from  
42 other measured piles (California Department of Transportation 2009). If it is assumed that each pile  
43 requires 500 strikes, and eight piles are impact driven in a day (4,000 strikes total) as a reasonably  
44 conservative scenario, the SEL<sub>cumulative</sub> level above 187 dB is calculated to extend approximately  
45 1,800 feet from the pile. If an attenuation device is used (e.g., isolation casing or bubble curtain),

1 source sound levels would be 10 dB SEL less (167 dB), and the distance to attenuation to 187 dB  
2 SEL<sub>cumulative</sub> would be reduced to approximately 390 feet. Similarly, the distance to attenuate to the  
3 183 dB SEL<sub>cumulative</sub> would be 453 feet.

4 As noted earlier, installation of piles with a vibratory driver does not produce underwater sound  
5 sufficient to exceed the interim criteria and would not cause direct physical injury to fish. However,  
6 vibratory driving can result in non-injurious adverse effects on fish (modification of behavior). Fish  
7 may respond by avoiding the area during active vibratory driving, which could result in temporary  
8 delays in migration, or place the fish at greater risk of predation by forcing them into areas with  
9 greater densities of predators or conditions that increase predator efficiency.

10 Should impact driving of piles be required, fish in the vicinity of the intake and barge unloading  
11 facilities on days when impact driving occurs could be exposed to underwater noise levels exceeding  
12 the SEL<sub>cumulative</sub> interim criteria (data show that the peak criterion would not be exceeded based on  
13 the pile size/type assumed for this project). Mapbooks M3-1, M3-2, M3-3, and M3-4 show the  
14 locations of the intakes and barge unloading facilities. Table 11-4 illustrates the potential for  
15 presence of covered species (by life history stage) in the areas of the Delta where the intakes (north  
16 Delta) and the barge unloading facilities (east and south Delta) are located. Table 11-8 indicates the  
17 approximate area of waterbodies exposed to underwater sound levels exceeding the 183-dB  
18 SEL<sub>cumulative</sub> level.

1 **Table 11-8. Length, Width, and Area of Waterbodies Potentially Exposed to Impact Pile Driving**  
 2 **Noise above the 183-dB SEL<sub>cumulative</sub> Level Based on Preliminary Estimates**

Intake or Barge Unloading Facility	Length of Water Body Experiencing Sound Levels above 183 dB SEL <sub>cumulative</sub> (feet)	Width of Water Body Experiencing Sound Levels above 183 dB SEL <sub>cumulative</sub> (feet)	Area of Water Body Experiencing Sound Levels above 183 dB SEL <sub>cumulative</sub> (square feet [acres])
Intake 1	6,560 <sup>a</sup>	425	2,788,000 [64]
Intake 2	6,560 <sup>a</sup>	645	4,231,200 [97]
Intake 3	6,560 <sup>a</sup>	560	3,673,600 [84]
Intake 4	6,560 <sup>a</sup>	615	4,034,400 [93]
Intake 5	6,560 <sup>a</sup>	535	3,509,600 [91]
Walnut Grove Landing	906 <sup>b</sup>	300	271,800 [6.2]
Tyler Island Landing	906 <sup>b</sup>	400	362,400 [8.3]
Venice Island Landing	906 <sup>b</sup>	150	135,900 [3.1]
Bacon Island Landing	906 <sup>b</sup>	350	317,100 [7.3]
Woodward Island Landing	906 <sup>b</sup>	380	344,280 [7.9]
Victoria Island Landing	906 <sup>b</sup>	380	344,280 [7.9]
Byron Tract Italian Slough Landing	900	400	362,400 [8.3]
Bouldin Island San Joaquin River Landing	900	900	815,400 [18.7]
Staten Island South Mokelumne River Landing	900	800	724,800 [16.6]

<sup>a</sup> Note—based on NMFS model—the single-strike sound exposure level (SEL) for impact cofferdam pile driving would attenuate to 150 decibels (dB), [which is not considered to harmfully accumulate] at 1,000 meters (3,280 feet); thus the maximum distance [upstream plus downstream combined] that would be exposed to 183 dB SEL<sub>cumulative</sub> would be 6,560 feet.

<sup>b</sup> Note—based on NMFS model—for 24-inch-diameter impact pile driving with bubble curtain, the single-strike SEL would attenuate to 150 dB, (which is not considered to harmfully accumulate) at 138 meters (453 feet); thus the maximum distance [upstream plus downstream combined] that would be exposed to 183 dB SEL<sub>cumulative</sub> would be 906 feet.

3  
 4 Depending on the number of strikes in a day, impact pile driving could result in injury to fish near  
 5 the pile driving. Table 11-9 summarizes the species that are potentially present between June and  
 6 October.

1 **Table 11-9. Species Present during Cofferdam Installation**

Species/Life Stage Present	Lifestage and Month(s) Present in Areas Affected by Underwater Sound during Cofferdam Installation
Delta smelt	Adult—June Larval—June, July
Chinook (fall-run)	Adults—August through October Juveniles—May
Chinook (late fall-run)	Adults—October Juveniles—June through October
Chinook (winter-run)	Adults—June/July Juveniles—September through October
Chinook (spring-run)	Adult—June through August
Steelhead	Adult—June through October Juvenile—June through October
Sacramento splittail	Adults—June through October Larvae—June Juveniles—June/July through October
Green sturgeon	Adult—June through October Juveniles—June through October
White sturgeon	Adults—June through October Juveniles—June through October Larvae—June
Pacific lamprey	Adults—June through August Ammocoetes—June through October
River lamprey	Adults—September/October Ammocoetes—June through October Macrophthalmia—June/July

2

3 Other underwater noise generated from surface equipment during construction of the water  
4 conveyance, such as that from boats and barges, may temporarily elevate underwater noise levels  
5 above ambient conditions.

## 6 **Effects on Water Quality**

7 The majority of intake construction would occur within the channel and channel banks behind  
8 cofferdams, although some channel contouring dredging would likely be required outside of the  
9 cofferdams. However, such dredging would be isolated from the river within a silt curtain enclosure.  
10 Therefore, any water quality effects would be minimal during construction. In addition, construction  
11 activities are likely to result in minimal effects on water quality because permit requirements would  
12 require implementation of BMPs and would restrict impacts on water quality. The potential effects  
13 of turbidity and suspension of potentially toxic sediments and accidental spills associated with  
14 construction activities are described below. Potential effects on water quality related to aquatic  
15 resources are summarized in Table 11-10.

1

**Table 11-10. Potential for Construction Activities to Affect Water Quality**

Activity	Location	Potential Effects	Avoidance and Minimization Measures
Installation of sheetpile for coffer dam	In-water	<ul style="list-style-type: none"> <li>Increased suspension of bottom sediments and turbidity</li> <li>Suspension of toxic-contaminated sediment</li> </ul>	<ul style="list-style-type: none"> <li>Section 404 and Section 10 permits would require implementation of BMPs to minimize suspension of bottom sediments</li> <li>Basin Plan requirements limit turbidity levels</li> </ul>
Pile driving	In-water	<ul style="list-style-type: none"> <li>Increased suspension of bottom sediments and turbidity</li> <li>Suspension of toxic-contaminated sediment</li> </ul>	
Foundation pile driving at intakes and dredging	Behind dewatered coffer dam	<ul style="list-style-type: none"> <li>None</li> </ul>	
Discharge of treated water from dewatering activities	In-water	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>Water would be treated prior to discharge and would meet NPDES permit requirements</li> </ul>
Channel contour dredging	In-water	<ul style="list-style-type: none"> <li>Increased suspension of bottom sediments and turbidity</li> <li>Suspension of toxic-contaminated sediment</li> </ul>	<ul style="list-style-type: none"> <li>Section 404 and Section 10 permits would require implementation of BMPs to minimize suspension of bottom sediments</li> <li>Basin Plan requirements limit turbidity levels</li> </ul>
Stormwater discharge (from upland construction areas)	In-water	<ul style="list-style-type: none"> <li>Small discharges from upland construction areas</li> </ul>	<ul style="list-style-type: none"> <li>Subject to NPDES permit requirements</li> </ul>
Accidental spills (from construction equipment)	In-water	<ul style="list-style-type: none"> <li>Small discharges of petroleum products</li> </ul>	<ul style="list-style-type: none"> <li>Pollution prevention programs</li> </ul>
Excavation for restoration	In-water	<ul style="list-style-type: none"> <li>Increase in suspended sediment</li> <li>Mobilization of toxic-contaminated sediment</li> </ul>	<ul style="list-style-type: none"> <li>Section 404 and Section 10 permits would require implementation of BMPs to minimize suspension of bottom sediments</li> <li>Basin Plan requirements limit turbidity levels</li> </ul>

Basin plan = Central Valley Regional Water Quality Control Board *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*.

BMPs = best management practices.

NPDES = National Pollutant Discharge Elimination System.

2

### 11.3.1.2 Potential Impacts Resulting from Water Operations

Consistent with the operational scenarios fully described in Chapter 3, Project Alternatives, changes in water operations could result in changes in flow and potentially changes in water quality, habitat, impingement, entrainment, and predation. Operational impacts on fish may include changes in spawning, migration, and rearing habitat associated with changes in reservoir operations, diversion of water, and the consequent changes in flow in the Sacramento River and water circulation and quality through the Delta. Potential entrainment or impingement of fish may be associated with the north Delta intakes and the change in the rate of entrainment or impingement by the south Delta diversions. Placement and operation of intakes may also result in changes in the potential for predation. Detailed discussions of these potential impacts are provided below for each alternative, beginning with the NAA (Section 11.3.4.1).

### 11.3.1.3 Potential Impacts Resulting from Restoration Measures

Restoration construction activities could affect covered fish species. Such effects include potential spills of construction equipment fluids; increased turbidity; increased exposure to methylmercury, pesticides and other contaminants when upland soils are inundated; and increased exposure to contaminants from disturbed aquatic sediments. However, these effects would be temporary and typically offset by the long-term benefits of the restored habitat.

Restoration would likely include pre-breach management of the restoration site to promote desirable vegetation and elevations within the restoration area and levee maintenance, improvement, or redesign. This may require substantial earthwork outside but adjacent to tidal and other aquatic environments. Levee breaching would require removing levee materials from within and adjacent to tidal and other aquatic habitats. These materials could be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Some restoration may include much more extensive construction activities, specifically restoration activities in the Yolo Bypass, where drainage and other agricultural facilities may need to be installed or relocated. Table 11-3 summarizes this information by conservation measure. In addition, maintenance activities associated with some of the conservation measures could entail limited in-water work, such as sediment removal, maintenance or replacement of water control structures, and replacement of instream woody material. Specific activities associated with the restoration-related conservation measures are discussed below.

### CM2 Yolo Bypass Fisheries Enhancements

Construction activities for Fremont Weir and Yolo Bypass are expected to include the following.

- Modifying Fremont Weir and Yolo Bypass
- Constructing a deep fish passage channel in Yolo Bypass
- Replacing the Fremont Weir fish ladder
- Constructing experimental sturgeon ramps at Fremont Weir
- Modifying the stilling basin
- Modifying the Sacramento Weir
- Modifying at the Tule Canal/Toe Drain

1       • Modifying lower Putah Creek

2       On a periodic basis, maintenance activities in the Yolo Bypass may include sediment removal from  
3       the Fremont Weir area using graders, bulldozers, excavators, dump trucks, or other machinery. A  
4       recent record of maintenance activities indicates that it would be reasonable to expect that  
5       approximately 1 million cubic yards (MCY) of sediment may be removed within 1 mile of the weir an  
6       average of every 5 years. An additional 1 MCY of sediment is conservatively anticipated to be  
7       removed inside the new channel every other year as part of routine sediment management  
8       activities. Where feasible, work will be conducted under dry conditions; if necessary, some dredging  
9       may be required to maintain connection along the deepest part of the channel for fish passage.

10       **CM4 Tidal Natural Communities Restoration**

11       Restoration of tidal natural communities would be undertaken in the Suisun Marsh, Cache Slough,  
12       West Delta, South Delta, and Cosumnes/Mokelumne ROAs. Construction for tidal habitat restoration  
13       is likely to involve the following activities.

- 14       • Excavating channels to encourage the development of sinuous, high-density dendritic channel  
15       networks within restored marsh plain.
- 16       • Modifying ditches, cuts, and levees to encourage more natural tidal circulation and better flood  
17       conveyance based on local hydrology.
- 18       • Infrastructure removal or relocation, including levee breaching to restore tidal connectivity.
- 19       • Removal of existing levees or embankments or creation of new structures to allow restoration to  
20       take place while protecting adjacent land.
- 21       • Prior to breaching, recontouring the surface to maximize the extent of surface elevation suitable  
22       for establishment of tidal marsh vegetation (marsh plain) by scalping higher elevation land to  
23       provide fill for placement on subsided lands to raise surface elevations.
- 24       • Prior to breaching, importing dredge or fill and placing it in shallowly subsided areas to raise  
25       ground surface elevations to a level suitable for establishment of tidal marsh vegetation (marsh  
26       plain).
- 27       • Prior to breaching, cultivating stands of tules through flood irrigation for sufficiently long  
28       periods to raise subsided ground surface to elevations suitable to support marsh plain, and  
29       breaching levees when target elevations are achieved. Irrigation infrastructure and levees would  
30       need to be installed or retained to control irrigation during the establishment period.
- 31       • Tidal habitat restored adjacent to farmed lands or lands managed as freshwater seasonal  
32       wetlands may require construction of dikes to maintain those land uses.

33       **CM5 Seasonally Inundated Floodplain Restoration**

34       The following activities may be associated with restoration of floodplains.

- 35       • Lowering the elevation of restored floodplain surfaces or modifying river channel morphology  
36       to increase inundation frequency and duration, and to establish elevations suitable for the  
37       establishment of riparian vegetation by either active planting or allowing natural establishment.
- 38       • Setting levees back along selected river corridors and removing or breaching levees.

- 1 • Removing existing riprap or other bank protection to allow for channel migration between the
- 2 set-back levees through the natural processes of erosion and sedimentation.
- 3 • Modifying channel geometry in unconfined channel reaches or along channels where levees are
- 4 set back in order to create backwater habitat.
- 5 • Selectively grading restored floodplain surfaces to provide for drainage of overbank flood
- 6 waters such that the potential for fish stranding is minimized.
- 7 • Actively establishing riparian habitat on floodplains.

## 8 **CM6 Channel Margin Habitat Enhancement**

9 Channel margin enhancement actions will often be implemented in conjunction with seasonally  
 10 inundated floodplain and riparian habitat restoration conservation measures (CM5 and CM7,  
 11 respectively), and could consist of the following.

- 12 • Removal of riprap from channel margins where levees are set back to restore seasonally
- 13 inundated floodplains.
- 14 • Modification of the outboard side of levees or setback levees to create low floodplain benches
- 15 with variable surface elevations that create hydrodynamic complexity and support emergent
- 16 vegetation.
- 17 • Installation of large woody material (e.g., tree trunks and stumps) into constructed low benches
- 18 or into existing riprapped levees to provide physical complexity.
- 19 • Planting of riparian and emergent wetland vegetation on created benches.

## 20 **CM7 Riparian Natural Community Restoration**

21 Riparian habitat restoration would include establishment or re-establishment of forest and scrub  
 22 vegetation in restored floodplain areas (CM5), consistent with floodplain land uses and flood  
 23 management requirements.

## 24 **CM10 Nontidal Marsh Restoration**

25 Nontidal marsh restoration would include establishment of connectivity with the existing water  
 26 conveyance system and grading to create wetland topography.

### 27 **11.3.1.4 Potential Impacts Resulting from Other Conservation Measures**

28 Other conservation measures that include construction activities with the potential to affect covered  
 29 fish species are CM12–CM19 and CM21. All of these conservation measures would require at least  
 30 some in-water work to install and/or remove facilities. Additionally, some work would be on the  
 31 levee or bank adjacent to aquatic habitat. CM16 specifically involves installing piles to support the  
 32 nonphysical barrier structure within the channel, in addition to placing telemetry equipment  
 33 upstream and downstream of the barrier. Depending on the exact location, vegetation or riprap may  
 34 need to be removed to ready the channel for the piles and the remainder of the structure (light,  
 35 sound, and air supply).

## 11.3.2 Methods for Analysis

### 11.3.2.1 Entrainment Analysis

Entrainment occurs when fish are removed from a water body as water is diverted. In the Delta, entrainment occurs at several locations, including the south Delta SWP/CVP intake facilities, Mirant power plants, agricultural diversions, and other intake facilities such as those operated by Contra Costa Water District (CCWD) and Freeport Regional Water Authority (FRWA) (ICF International 2012; USFWS 1008; California Department of Water Resources 2005). Entrainment has been a major issue of concern related to the aquatic species covered in the BDCP, and as such must be evaluated carefully in the EIR/EIS. A key element of the BDCP is the proposed new intake facilities in the north Delta, which would allow for more effective screening of fish and less reliance on the south Delta facilities. This component of the BDCP is intended to reduce entrainment through changes in Delta water management.

The methods used to assess entrainment risk are based on historical salvage data, CALSIM outputs, assumed and measured locations of fish, previous studies in the Delta, Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) analyses, life cycle models, and professional judgment. The methods used reflect the best available tools and data regarding fish abundance, movement, and behavior. These methods were applied to a comparison of baseline conditions with conditions under the alternatives. For some methods, five water-year types were modeled based on the historical CALSIM record to determine the variation in entrainment under different flow conditions. In general, however, there is a lack of population level data species and their baseline populations are not well understood. For a complete description of the methods, please see *BDCP Effects Analysis – Appendix B, Entrainment, Section B.5 Methods of Biological Analysis (hereby incorporated by reference)*.

The methods used to evaluate entrainment are listed below.

- **Salvage density:** uses historical salvage data and CALSIM outputs to estimate entrainment under various flow conditions.
- **Old and Middle River (OMR) flow proportional entrainment regressions:** uses linear regression (based on USFWS 2008) and incorporates the adjustment of Kimmerer (2011) and CALSIM data to estimate the proportion of delta smelt population that would be entrained.
- **DSM2 particle-tracking model:** uses data from Interagency Ecological Program (IEP) from trawls to estimate the movement of larval delta smelt and larval longfin smelt that are assumed to be influenced primarily by flows.
- **Effectiveness of nonphysical barriers:** uses results of recent studies at Georgiana Slough and Old River to determine potential effectiveness of barriers in other Delta locations that would exclude fish from diversions.
- **North Delta intakes screening effectiveness analysis:** estimates direct loss and impingement at screens for different sizes of fish based on literature and professional judgment.
- **DRERIP analysis of nonproject diversions:** assumes that removal of nonproject diversions would result in a reduction in entrainment.

No single one of these methods could be used for all life stages of all species. Accordingly, it was necessary to use these methods in combination to complete the assessment of entrainment. For

1 example, the OMR regression is applicable only to delta smelt. Similarly, the assessment of the north  
 2 Delta screening efficiency was specific to that facility and focused primarily on larval life stages.  
 3 Each of these analytical methods have technical limitations, which are generally described in the  
 4 Entrainment Appendix to Chapter 5.

5 These methods were applied to each species and life stage as appropriate, and the results of the  
 6 assessment are presented in *Determination of Adverse Effects*. The conclusions presented in the  
 7 analysis synthesize multiple results because multiple methods were applied to some species and life  
 8 stages.

### 9 **11.3.2.2 Flow, Passage, Salinity, and Turbidity Analysis**

10 The methods used to assess flows and the various flow-related parameters are based on CALSIM  
 11 and DSM2 outputs, upstream temperature models (e.g., Reclamation temperature model,  
 12 Sacramento River Water Quality Model [SRWQM]), Particle Tracking Model (PTM), multiple  
 13 biological models, assumed and measured locations of fish, previous studies in the Delta, Delta  
 14 Regional Ecosystem Restoration Implementation Plan (DRERIP) analyses, life cycle models, and  
 15 professional judgment. A full description of these methods and a complete analysis can be found in  
 16 the *BDCP Effects Analysis – Appendix C, Flow, Passage, Salinity, and Turbidity Appendix (hereby*  
 17 *incorporated by reference)*. Fifteen different models or indices were used to evaluate flow-related  
 18 effects. As with all analytical tools, these methods have technical limitations that are discussed in the  
 19 appendices to Chapter 5. These methods were applied to a comparison of the alternatives with  
 20 existing conditions and the No Action Alternative. For some methods, five water-year types were  
 21 modeled based on the historical CALSIM record to determine the variation in flow-related effects  
 22 under different flow conditions. Data and analyses are presented in *Appendix 11C CALSIM II Model*  
 23 *Results Utilized in Fish Analysis* and are incorporated into tables and discussion throughout this  
 24 chapter. Although it is recognized that there are statistically significant correlations between  
 25 freshwater flow and abundances of several fish species (e.g., Kimmerer 2002, USFWS 2005), these  
 26 correlations were not used in the EIR/EIS analysis to estimate fish population responses to  
 27 alternatives because they do not directly include the effects of tidal marsh and floodplain restoration  
 28 on fish populations.

29 Physical modeling outputs each month and water year type were compared for between model  
 30 scenarios at multiple locations to determine whether there were differences between scenarios at  
 31 each location. A “difference” was defined as a >5% difference between the pair of model scenarios in  
 32 at least one water year type in at least 1 month. If a difference was found at a location, subsequent  
 33 biological modeling and analyses for fish species that occur in that location were conducted and  
 34 reported for that location. If no differences were found, subsequent biological modeling and  
 35 analyses for fish species that occur in that location were deemed unnecessary and were not  
 36 conducted. These instances are noted in the text as they occur. Locations include individual rivers or  
 37 river reaches and vary according to the species and life stage analyzed. The time ranges analyzed  
 38 also vary by species and life stage.

39 Following is a summary of the primary models or indices used to evaluate flow-related effects.

- 40 ● **CALSIM:** The CALSIM II planning model simulates the operation of the CVP and SWP over a  
 41 range of hydrologic conditions based on an assumed set of demands, regulatory requirements  
 42 and climate-related factors using an 82-year record of hydrology. CALSIM II produces key  
 43 outputs that include river flow volumes and diversion volumes, reservoir storage, Delta flow  
 44 volumes and export volumes, Delta inflow volumes and outflow volumes, deliveries to project

1 and nonproject users, and controls on project operations. The model operates at a monthly time  
2 step, but for the BDCP analysis daily flows on the Sacramento River were used to estimate  
3 Fremont Weir diversions and north Delta intake bypass flow requirements. These daily  
4 Sacramento River flows were estimated from the historical daily patterns adjusted to match the  
5 monthly CALSIM flows.

- 6 ● **DSM2-HYDRO:** DSM2-HYDRO estimates flow rates, velocities, and depths for the Delta for a  
7 given scenario (e.g., the BDCP or climate change). It is tidally averaged. Outputs are used to  
8 determine the effects of these hydrodynamic parameters on covered terrestrial and fish species  
9 and as inputs to other biological models. The model operates at a 15-minute time step.
- 10 ● **Reclamation Temperature Model:** The Reclamation Temperature Model is used to assess the  
11 effects of operations on water temperatures in the Feather, Stanislaus, Trinity, and American  
12 river basins, which are then used as inputs to the Reclamation Salmon Mortality Model and  
13 species-specific habitat evaluations. The model operates at a monthly time step.
- 14 ● **Sacramento River Water Quality Model:** SRWQM is an application developed to use the HEC-  
15 5Q model to simulate mean daily (using 6-hour meteorology) reservoir and river temperatures at  
16 key locations in the Sacramento River from Shasta Dam to Knights Landing. Output  
17 (temperature and flow) from the SRWQM is used as an input to a number of biological models  
18 for upstream life stages of salmonids and sturgeon. The model operates at a daily time step.
- 19 ● **Delta Passage Model:** DPM simulates migration and mortality of Chinook salmon smolts  
20 entering the Delta from the Sacramento, Mokelumne, and San Joaquin Rivers through a  
21 simplified Delta channel network, and provides quantitative estimates of relative Chinook  
22 salmon smolt survival through the Delta to Chippis Island. DPM is used to estimate through-Delta  
23 survival for winter-, spring-, fall-, and late fall–run juvenile Chinook salmon passing through the  
24 Delta, as well as estimates of salvage in the south Delta export facilities. Model inputs are DSM2-  
25 HYDRO and CALSIM data. The model operates at a daily time step.
- 26 ● **Sacramento Ecological Flows Tool:** Links flow management actions to changes in the physical  
27 habitats and predicts effects of habitat changes to several fish species. The model operates at a  
28 daily time step.
- 29 ● **Reclamation Egg Mortality Model:** The Salmon Mortality Model is used to assess temperature-  
30 related proportional losses of eggs and fry for each race of Chinook salmon in the Trinity,  
31 Sacramento, Feather, American, and Stanislaus Rivers. The model operates at a daily time step  
32 and provides output on an annual time step.
- 33 ● **DRERIP:** Used to assess importance of stressors, develop methods, and aid in qualitative  
34 assessments of covered activities in the Plan Area.
- 35 ● **Longfin Smelt Winter-Spring X2–Abundance Regression:** Used to estimate relative  
36 abundance of longfin smelt in the fall based on winter-spring X2 (as an indication of outflow).  
37 Model input is from CALSIM data.
- 38 ● **Delta Smelt Abiotic Habitat Index:** Used to calculate area of delta smelt abiotic habitat in fall  
39 (September–December) based on the relationship described by Feyrer et al. (2011). Model input  
40 is CALSIM data for Fall X2.

### 11.3.2.3 Biological Stressors Analysis

Biological stresses are associated with the diverse interactions that occur among organisms of the same or different species. Biological stresses can result from competition, herbivory, predation, parasitism, toxins, and disease. As such, a wide variety of human activities can cause or enhance biological stress. In the Delta, the introduction of invasive species is recognized as a major stressor for the covered fish species (Mount et al. 2012, Aquatic Ecosystem Stressors; USFWS 1996, Delta Native Fishes Recovery Plan)<sup>3</sup>. The Delta is considered one of the most invaded estuaries in the world (Cohen & Carlton 1995). Species introductions and the relative biomass of nonnative species have been increasing since at least the nineteenth century as a function of increasing trade, boat traffic, recreation, as well as resource management activities. Introductions include numerous taxa, including copepods, shrimp, amphipods, bivalves, fish and both rooted and floating plants. Many planktonic species have been introduced through ballast water releases from large ships directly into the estuary. As a result, many of these introduced species originate from estuaries around the Pacific Rim, particularly copepods and mollusks. More than 250 nonnative aquatic and plant species have been introduced into the Delta (Cohen & Carlton 1995). Of these, at least 185 species have become established, and contribute to the alteration of the Delta's ecosystem. Current estimates suggest that more than 95% of the biomass in the Delta is composed of nonnative species. These introductions have resulted in a whole host of potential pathways that resulted in biological stress for covered fish.

The biological stress analysis focuses on the effects of invasive aquatic vegetation and predation by non-native fishes, two major stressors that are likely to be affected by implementation of the BDCP conservation measures. The scientific basis, analytical methods, and technical sources for evaluating potential project effects on these stressors and covered species are summarized below

#### Invasive Aquatic Vegetation

Within the Delta, invasive aquatic vegetation (IAV) reduces the amount and suitability of habitat for covered fish species in a number of ways through adverse effects on water quality, the foodweb and by physically obstructing covered fish species' access to habitat. Dense stands of IAV displace native aquatic plants and also provide suitable habitat for nonnative invasive fish species, which in turn reduce native species through predation. Native fish may also avoid the habitat conditions created by dense IAV (e.g., high water clarity, low DO).

The two most abundant aquatic invasive plants in the Delta are Brazilian waterweed (*Egeria densa*) and water hyacinth (*Eichhornia crassipes*). Brazilian waterweed has been present in the Delta for about 25 years and water hyacinth for over 100 years. Brazilian waterweed is a rooted aquatic perennial that grows in shallow, freshwater areas of the Delta. The plant grows long (up to 15 feet), and frequently branches stems that form very dense strands below the water surface. Brazilian waterweed is now the most abundant submerged aquatic vegetation (SAV) species in the Delta. Water hyacinth is a floating aquatic perennial that inhabits calm backwaters and other areas with low velocities. Individual plants join together and form thick, dense mats on the water surface. Because water hyacinth plants are not rooted in the substrate, their distribution is influenced by water currents and prevailing wind. During spring and summer, the dominant westerly winds often

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<sup>3</sup> For the purposes of this discussion, invasive species are generally considered those nonnative species that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically.

1 hold the plants against the lee shorelines or in backwaters of the Delta. In off-channel and backwater  
2 sites, hyacinth mats can become dense enough to close off open water completely. In fall, when the  
3 seasonally predominant westerly winds decline, mats of hyacinth float out into the main channels  
4 where they are moved about by the river and tidal currents. Current management programs have  
5 found that herbicide application is the most effective treatment for Brazilian waterweed in the Delta,  
6 and herbicide plus some mechanical treatment is the best available treatment for water hyacinth.  
7 While construction, maintenance, and operation effects of the BDCP are expected to alter the current  
8 distribution and densities of invasive species, a number of BDCP conservation measures are likely to  
9 reduce the biological stress associated with invasive aquatic vegetation. These include CM1, CM13,  
10 and CM20.

11 The analysis used for IAV is a qualitative evaluation of potential outcomes (beneficial and/or  
12 detrimental) of implementing BDCP conservation measures associated with reducing the effects of  
13 IAV on BDCP covered fish. It is based on information obtained from the scientific literature;  
14 consultations with local experts; and conceptual models of key processes, habitats, and covered fish  
15 species in the Delta. Review of existing conceptual models included models developed previously by  
16 the CALFED Ecosystem Restoration Program (ERP) implementing agencies (CDFW, USFWS, and  
17 NMFS) as part of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). Those  
18 conceptual models were developed to aid in CALFED's planning of potential ecosystem restoration  
19 actions in the Delta and are relevant to the BDCP.

20 A complete description of scientific basis, analytical methods, assumptions, and uncertainties for the  
21 IAV analysis can be found in *BDCP Effects Analysis – Appendix 5.F - Biological Stressors on Covered*  
22 *Fish*.

### 23 **Fish Predation**

24 Predator-prey dynamics are influenced by many interacting factors that directly and indirectly  
25 influence prey encounter and capture probabilities (Mather 1998; Nobriga and Feyrer 2007; Lindley  
26 and Mohr 2003). Factors affecting the opportunity and magnitude of predation include habitat  
27 overlap between predator and prey, foraging efficiency by predators, energetic demands of  
28 predator, size, life stage, behavior and relative numbers of predators and prey.

29 Although predation is a natural part of aquatic community dynamics, the possibility of increased  
30 predation rates by nonnative fish species has been identified as a stressor for BDCP covered fish  
31 species, such as delta smelt (Baxter et al. 2008), steelhead (Clark et al. 2009; National Marine  
32 Fisheries Service 2009b), and juvenile Chinook salmon (Good et al. 2005; Moyle 2002; National  
33 Marine Fisheries Service 2009b). Elevated predation rates are considered a potential indirect effect  
34 of water diversion operations (Brown et al. 1996) and a potential hindrance to shallow-water  
35 habitat restoration (Brown 2003; Nobriga and Feyrer 2007). Predatory fish species of particular  
36 concern in the Delta are striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*)  
37 and Sacramento pikeminnow (*Ptychocheilus grandis*). Nobriga and Feyrer (2007) found numerous  
38 invertebrate and fish taxa in the diets of these common species. Many predatory fish species,  
39 including striped bass and largemouth bass, are nonnative. Habitat structure and heterogeneity can  
40 affect opportunities for encounter and capture by predators. In open water habitats, striped bass are  
41 the most likely primary predator of juvenile and adult delta smelt. Other species, such as largemouth  
42 bass, are ambush predators that remain close to cover such as in water structures or aquatic  
43 vegetation. A number of BDCP conservation measures are likely to reduce the biological stress  
44 associated with fish predation. These include CM1–CM6, CM13, CM16, and CM21.

1 For fish predation, best professional judgment based on the available scientific information was  
2 used to characterize predator distribution and abundance within Delta habitats, covered fish species  
3 losses attributed to predation, and the anticipated effectiveness of the predator control conservation  
4 measures on predation impacts in Delta. This included information from studies of marked or radio  
5 tagged steelhead, Chinook salmon and delta smelt at the SWP CCF (Gingras 1997; Clark et al. 2009;  
6 Castillo et al. 2012) and Chinook salmon at the San Joaquin River and head of Old River (Bowen et al.  
7 2009). Other studies provided information on Delta habitat use by covered fish species and  
8 nonnative predators (Nobriga et al. 2005; Nobriga and Feyrer 2007) and the effectiveness of fish  
9 predator control efforts in the Delta (Cavallo et al. 2012) and elsewhere (Mueller 2005; Porter  
10 2010).

11 Three quantitative analyses were used to estimate predation-related effects of water diversions and  
12 facilities (CM1). For the south Delta facilities, pre-screen entrainment losses that are typically  
13 ascribed to predation were presumed to be commensurate with salvage density.

14 For the new north Delta intakes, bioenergetics modeling was used to estimate relative consumption  
15 of Chinook salmon by striped bass. The original model estimated consumption based on water  
16 temperature, striped bass size, striped bass density at the screen, and the density and size of prey  
17 encountered (Loboschefskey and Nobriga 2010; Loboschefskey et al. 2012). Another rough estimate of  
18 predation losses at the north Delta intakes was an assumption of a fixed 5% loss for each intake  
19 passed by outmigrating juvenile Chinook salmon, as proposed by NMFS. A complete description of  
20 methods and the resulting analysis can be found in the *BDCP Effects Analysis – Appendix F, Biological*  
21 *Stressors, Section 5F.0.2.2 Fish Predation and Section 5F.3.2 Fish Predation Analysis (hereby*  
22 *incorporated by reference).*

#### 23 **11.3.2.4 Contaminants Analysis**

24 To evaluate effects on covered fish species, published data on occurrence, biogeochemical behavior,  
25 mass balances, quantitative modeling tools, and studies of impacts of specific toxic constituents on  
26 covered fish species were reviewed. A broad range of studies are available specific to the Central  
27 Valley and Delta region, some of which are referenced in this analysis. The objective of the analysis  
28 is to provide an overview of how these constituents could become more bioavailable to covered fish  
29 species in the Plan Area and whether there is potential for the alternatives to result in effects on  
30 covered fish species. A complete analysis can be found in the *BDCP Effects Analysis – Appendix D,*  
31 *Contaminants (hereby incorporated by reference).*

32 The action alternatives involve substantial restoration that would be implemented throughout the  
33 Delta over the 50-year implementation period as well as changes in water operations that could  
34 change how some toxins move through the Delta. Restoration of land with metals and pesticides in  
35 soils that could be mobilized into the aquatic system when inundated is expected to increase the  
36 bioavailability of some toxins to covered fish species. Conversely, taking lands out of agricultural use  
37 may result in an overall reduction of agriculture-related toxin loading, including pesticides, copper,  
38 and in some cases, concentrated selenium in irrigation drainage.

39 Given the current understanding of the complex processes involved in mobilizing these toxins, it  
40 cannot be modeled or quantified on a BDCP wide basis with any confidence. The analysis presented  
41 here provides a conceptual framework to understand the relevant processes. Site-specific analyses  
42 of restoration areas will be required to estimate the magnitude of the effects. The amount of toxins  
43 that would be mobilized and made more bioavailable to covered fish species due to inundation of

1 ROAs is uncertain. This uncertainty is most critical for methylmercury, and to a lesser extent for  
2 pesticides and other metals. For each of the toxins, the chemical-specific and site-specific factors  
3 that will determine resultant effects vary. CM12 is included in the project (see Chapter 3) to support  
4 site specific evaluation and monitoring of methylmercury production in restored areas. Data from  
5 this monitoring will assist in evaluating the effects of restoration actions and reduce the uncertainty  
6 associated with the potential exposure of covered fish to methylmercury mobilized by these actions.

### 7 **11.3.2.5 Habitat Restoration Analysis**

8 This analysis relies on a combination of qualitative and quantitative methods to evaluate the effects  
9 of the proposed restoration activities. In addition to literature review, these methods include a  
10 habitat suitability index (HSI) approach, based on data obtained from trawls and CALSIM, DSM2, and  
11 RMA Bay-Delta model outputs, and a Habitat Productivity Analysis. The habitat suitability analysis  
12 focuses on the direct benefits to fish in terms of increased habitat availability. The analysis of habitat  
13 productivity considers the indirect benefits to fish from improved ecological functions in restored  
14 habitats, with a focus on food production. A summary of methods for each conservation measure is  
15 provided below. A complete discussion of methods for each conservation measure can be found in  
16 the *BDCP Effects Analysis – Appendix E, Habitat Restoration (hereby incorporated by reference)*.

17 Detailed plans for restoration, enhancement, and preservation areas have not been prepared for  
18 multiple reasons: (1) because the habitat restoration and enhancement would occur, if feasible, in  
19 areas with willing sellers, none of whom have been identified; (2) to maintain flexibility in the BDCP  
20 for adaptive management; and (3) because BDCP implementation has a long timeframe. However,  
21 although specific locations proposed for habitat restoration and enhancement have not been defined  
22 at this time, the EIR/EIS must quantify the environmental effects to the degree of specificity  
23 available for the project description. Therefore, the assessment of the effects for the habitat  
24 restoration and enhancement was programmatic. The analysis focused on the restoration  
25 opportunity areas (ROAs) identified in the BDCP. ROAs were established to assist in the  
26 development of the BDCP conservation strategy. ROAs encompass those locations considered to be  
27 the most appropriate for the restoration of tidal habitats within the Plan Area and within which  
28 restoration goals for tidal and associated upland natural communities will be achieved. The ROAs  
29 are large land areas centered on Suisun Marsh, the West and South Delta areas, Cache Slough and  
30 the Cosumnes/Mokelumne area in the east Delta (Figure 3-1). Individual project-level  
31 environmental review based on more detailed plans will be required for these actions before  
32 implementation.

## 33 **CM4 Tidal Habitat Restoration**

### 34 **Habitat Suitability Analysis**

35 The analysis of tidal marsh restoration focuses on the change in the quantity and quality of habitat  
36 available to each species and life stage. The potential value of the restored habitat is determined  
37 using a habitat suitability approach (Schamberger et al. 1982). This technique captures knowledge  
38 about the habitat requirements of species in the form of ratings that are integrated to derive a  
39 Habitat Suitability Index or HSI. The HSI is a measure of the dynamic quality of habitat condition  
40 with respect to the species/life stage requirements. The species-specific HSI is then applied to the  
41 total quantity of available or restored habitat to derive habitat units (HUs). HUs are the  
42 interpretation of the habitat types (e.g., deep water, intertidal, shallow water) from the perspective  
43 of a species and life stage.

1 The analysis addresses habitat at a macro-scale ranging from hundreds to thousands of acres of land  
 2 that potentially would be flooded to provide aquatic habitat. The analysis does not address specific  
 3 restoration actions that will occur at smaller scales. Specific actions or restoration sites have not  
 4 been identified as part of the BDCP. Instead, the measure provides a general outline of areas and  
 5 schedules for habitat restoration. The general description of actions in the conservation measure  
 6 has been expanded for this analysis by estimating acreages, tidal condition, and depth of areas in  
 7 each ROA that potentially would be flooded as dikes were breached. These estimates were derived  
 8 through application of the RMA Bay-Delta model, CALSIM, DSM2, and geographic information  
 9 systems (GIS). These refined estimates of restored areas then were evaluated using the habitat  
 10 suitability analysis.

11 Application of Habitat Suitability Analysis integrates habitat suitability models for multiple habitat  
 12 attributes for different life stages of species. Habitat suitability models describe the suitability of a  
 13 habitat attribute such as temperature to the survival of the life stage, for example Delta smelt eggs.  
 14 As such, for each species evaluated using the habitat suitability approach (delta smelt, salmonids,  
 15 etc.), specific characteristics were assigned ratings for each life stage (Table 11-11). These individual  
 16 suitability models attempt to capture how the species perceives the environmental condition  
 17 presented currently or what might occur due to habitat restoration. Suitability models were derived  
 18 from review of available literature and consultation with regional species experts. The results of the  
 19 analysis are captured as Habitat Units (HUs) that are the product of the area of various habitat types  
 20 (shallow, intertidal and deep) and the HSI ratings for the same areas. The determination of HUs also  
 21 incorporates the concept of key habitat types for life stages. This allows consideration of life stages  
 22 selecting particular types of environments over others. However, this is not a comprehensive  
 23 evaluation of habitat because not all species and life stages have been modeled, only a few of the  
 24 many habitat attributes have been included, and habitat beneficial to one species is not necessarily  
 25 beneficial to others. In addition, the attributes are averaged over relatively large areas, at the ROA  
 26 level.

27 **Table 11-11. Attributes Evaluated Using the Habitat Suitability Index**

Species Life Stage	Attributes
Delta smelt eggs	Temperature, salinity
Delta smelt larvae	Temperature, salinity, turbidity
Delta smelt juveniles	Temperature, salinity, turbidity
Salmonid fry	Temperature, turbidity, dissolved oxygen
Splittail juveniles	Depth
Splittail adults	Depth

28  
 29 The results of the HSI are combined for each evaluated species in each ROA and presented in HUs to  
 30 show the estimated quantity and quality of the restored habitats for each of the species evaluated.

### 31 **Habitat Productivity**

32 The Habitat Productivity Analysis was designed to optimistically assess potential food web  
 33 enhancements that may result from proposed tidal habitat restoration activities. The analysis  
 34 examined two main sources of foodweb support: phytoplankton production and marsh-derived  
 35 production.

1 The relationship between phytoplankton growth rate and depth developed by Lopez and coauthors  
 2 (2006) was used to characterize how habitat restoration could contribute to the phytoplankton-  
 3 based foodweb. This relationship was applied to the estimated depths for each tidal-area stratum. In  
 4 addition, a consideration of the area of habitat of an average depth was added to the estimates of  
 5 phytoplankton growth rate. It was assumed that a larger area of a given phytoplankton growth rate  
 6 has a greater value than a smaller area with the same rate. To capture this notion, the phytoplankton  
 7 growth rate was first calculated from the estimated average water depth of each tidal-area stratum,  
 8 and then multiplied by the area of the stratum, resulting in a metric termed “prod-acres”  
 9 (phytoplankton growth rate X area). The analysis provided estimates of phytoplankton growth rate,  
 10 depth, and calculated prod-acres by ROA and implementation period. The contribution of the  
 11 detrital pathway to marsh production was examined on the basis of an analysis by Kneib (2003),  
 12 which included estimates of the amount of production flowing to resident nekton (actively  
 13 swimming aquatic species) as well as the export of production to the estuary by means of a “trophic  
 14 relay” by migrant nekton.

### 15 **CM5 Seasonally Inundated Floodplain**

16 The analysis of seasonally inundated floodplains follows The Delta Conceptual Models (Opperman  
 17 2012), which include both ecosystem element models (including process, habitat, and stressor  
 18 models); and species life history models. The Delta Conceptual Models are qualitative models which  
 19 describe current understanding of how the system works (DiGennaro et al. 2012). They are  
 20 designed and intended to be used by experts to identify and evaluate potential restoration actions.  
 21 They are not quantitative, numeric computer models that can be “run” to determine the effects of  
 22 actions. Rather they are designed to facilitate informed discussions regarding expected outcomes  
 23 resulting from restoration actions and the scientific basis for those expectations.

24 The floodplain restoration will be evaluated by measuring;

- 25 ● Seasonally inundated floodplain restoration sites along channels in the north, east, and south  
 26 Delta.
- 27 ● Large-scale floodplain restoration in the south Delta along the San Joaquin River, Old River, and  
 28 Middle River.
- 29 ● Increases in food availability (phytoplankton, zooplankton, insects, and small fish) resulting  
 30 from increased floodplain inundations. Enhancement of both primary production and  
 31 zooplankton growth.
- 32 ● Increases in the quantity quality of accessible rearing habitat for juvenile salmon and splittail.
- 33 ● Levee setbacks, removal of riprap, and grading of floodplain activities.

### 34 **CM6 Channel Margin Enhancement**

35 Existing channel margin habitat conditions of importance to fish were summarized using the  
 36 Sacramento River Bank Protection Project revetment database (U.S. Army Corps of Engineers 2007).  
 37 This database covers levees that are part of the Sacramento River Flood Control Project. Within the  
 38 Plan Area, the major channels important to covered fish species that are included in the database  
 39 are:

- 40 ● Sacramento River: full extent
- 41 ● Georgiana Slough: full extent

- 1       • Sutter and Steamboat Sloughs: full extents
- 2       • Miner Slough: full extent
- 3       • Cache Slough: partial extent

4       The revetment database was used to summarize several features of existing habitat that may be  
 5       important to covered fish species, including water depth, presence of revetment, emergent  
 6       vegetation coverage, overhead cover, and woody material. The summary of bankline features was  
 7       used together with a literature review to provide context for the potential benefits of CM6 Channel  
 8       Margin Habitat Enhancement.

## 9       **CM7 Riparian Habitat Restoration**

10       Methods for evaluation include both quantitative and qualitative methods to estimate the effects of  
 11       the proposed restoration activities. In addition to literature review, these methods include a habitat  
 12       suitability index (HSI) approach, based on data obtained from trawls and CALSIM, DSM2, and RMA  
 13       Bay-Delta model outputs, and a Habitat Productivity Analysis. The habitat suitability analysis  
 14       focuses on the direct benefits to fish in terms of increased habitat availability. The analysis of habitat  
 15       productivity considers the indirect benefits to fish from improved ecological functions in restored  
 16       habitats, with a focus on food production. This includes the evaluation and use of monitoring  
 17       strategies and results from relevant studies in the watershed (Sacramento River Riparian  
 18       Monitoring and Evaluation Plan by Shilling et al. 2011 and Golet et al. 2008).

### 19       **11.3.2.6       Reservoir Coldwater Fish Habitat Analysis**

20       Upstream reservoirs that may be affected by changes in delivery of water are analyzed to determine  
 21       the effects on coldwater fish habitat. According to Moyle (2002, pg 36, 37), foothill water supply  
 22       reservoirs of the Central Valley can be described with four major habitat zones: 1) the littoral or  
 23       edge-water habitat around the shoreline of the reservoir, 2) the epilimnetic or near-surface habitat  
 24       located above the thermocline (water temperature gradient) and generally in the euphotic zone  
 25       (>1% of surface light) where phytoplankton grow, 3) hypolimnetic or deep-water habitat located  
 26       below the thermocline, where the water temperatures remain less than 15°C (59°F) during the  
 27       stratified spring-summer and fall months, and 4) the deepwater benthic habitat located near the  
 28       bottom of the hypolimnetic portion of the reservoir. There are relatively distinct fish assemblages  
 29       within each of these habitat zones, with different feeding and reproductive behaviors (strategies).  
 30       Reservoirs are generally less productive (lower fish biomass and growth rates) than lakes of a  
 31       comparable surface area because reservoir water surface elevations fluctuate more and have  
 32       steeper slopes, which limits the littoral benthic zone, and may interfere with reproduction (Moyle  
 33       2002 pg 36).

34       Seasonal temperature stratification (vertical water temperature gradient) and phytoplankton  
 35       production in the epilimnetic near-surface zone are the dominant seasonal habitat features of  
 36       reservoirs. The evaluation of possible effects of reservoir operations simulated for the action  
 37       alternatives on reservoir fish populations considers the effects on warm-water fish in the  
 38       epilimnetic and littoral habitat zones together, and will consider the coldwater fish in the  
 39       hypolimnetic and deep water benthic habitat zones together. In some lakes and reservoirs, the  
 40       dissolved oxygen in the hypolimnion can become depleted from inflowing organic materials or,  
 41       more commonly, by settling of detritus from the productive epilimnion. Lake Almanor is a good  
 42       example of this condition in California. Low dissolved oxygen is not a problem in the major CVP and

1 SWP reservoirs, however, and will not be included in the coldwater habitat evaluation. Because the  
2 water depths are relatively shallow and water surface elevations of the regulating reservoirs (i.e.,  
3 Lewiston, Whiskeytown, Keswick, Thermalito, Natoma, and Tulloch Reservoirs) are largely  
4 independent of flow, the habitat conditions are similar from year to year, and the fish populations in  
5 the regulating reservoirs are stable; fish populations in these regulating reservoirs are not evaluated  
6 for the BDCP alternatives.

7 Although the seasonal variations in water surface elevations (storage level), temperature  
8 stratification and primary production (light availability) in the major water supply reservoirs are  
9 somewhat similar from year to year, the end-of-water-year (end-of September) storage volumes can  
10 be quite different. Because the water supply reservoirs are generally filled in the spring and are  
11 drawn-down during the summer and fall for water supply releases, the minimum storage each year  
12 usually occurs in September (or October) and can be greatly reduced in a sequence of dry years (i.e.,  
13 drought). Drawdown of reservoir storage from June through October can diminish the volume of  
14 cold water, thereby reducing the amount of habitat for coldwater fish species during these months.  
15 Kokanee salmon and rainbow trout are common coldwater species that support important  
16 recreational fisheries in Central Valley reservoirs. Potential impacts can therefore be assessed based  
17 on the availability of suitable water temperatures for these species during the late summer or early  
18 fall when coldwater habitat is most restricted. Preferred habitat for kokanee is well-oxygenated  
19 open water in reservoirs where temperatures are 50–59° F, while rainbow trout growth is optimal  
20 when temperatures are around 59°F–64°F (Moyle 2002). Thus, a water temperature index of 60 °F  
21 was used in the following assessment as a general indicator of the availability of coldwater habitat in  
22 Central Valley reservoirs. This temperature index is specific to analysis of reservoir operations,  
23 while areas downstream of the reservoirs use a different temperature index (National Marine  
24 Fisheries Service 2009a, 2009b).

25 The basic approach is to determine the relationship between total storage volume and the coldwater  
26 volume in each reservoir. The maximum suitable temperature for the coldwater habitat was  
27 assumed to be 60°F. The minimum coldwater habitat volume or the reduction in coldwater habitat  
28 volume that would be classified as a substantial change must be identified for each reservoir. Finally  
29 the percentage of additional years (out of the 82-year simulation period) that would be considered  
30 an adverse effect on the fish populations within each reservoir must be determined. The methods  
31 for coldwater reservoir fish is based on an analysis of Shasta Reservoir; the approach for Shasta  
32 Reservoir is then combined with the results from the CALSIM modeling for the other major CVP and  
33 SWP reservoirs, along with the selected minimum coldwater habitat volumes. This information is  
34 used for the coldwater habitat impact evaluation for each alternative (Appendix 11C, CALSIM II  
35 Model Results utilized in the Fish Analysis).

### 36 **11.3.2.7 Methods Used to Consider Mitigation**

37 The construction and operation of the project or its alternatives would result in a range of short-  
38 term and long-term effects on environmental conditions in the Sacramento River and the Delta. This  
39 would in turn result in a range of direct and indirect effects on fish and aquatic resources that  
40 depend on the affected habitats. The BDCP conservation measures have been designed to avoid and  
41 minimize such impacts where possible and improve habitat conditions. The project also  
42 incorporates environmental commitments (referred to as Avoidance and Minimization Measures in  
43 the BDCP Effects Analysis) which have been designed to avoid and minimize effects where possible.  
44 To the extent that effects remain, and such effects are deemed to be adverse or significant, feasible  
45 measures will be implemented to mitigate these effects to less-than-significant levels.

1 The potential environmental effects of the alternatives have been analyzed independently below.  
 2 The potential effects on fish species created by each BDCP element (the CMs) have also been  
 3 independently identified. All effects identified as adverse and potentially significant have been  
 4 evaluated for the feasibility of mitigation after first considering whether the conservation measures  
 5 or environmental commitments built into the BDCP would lessen the significant adverse  
 6 environmental effects. Permanent and temporary impacts have been treated the same for  
 7 considering the need for mitigation.

8 In situations where neither the conservation measures or the environmental commitments (which  
 9 include Best Management Practices [BMPs]) are capable of adequately avoiding or minimizing  
 10 potential adverse effects, mitigation measures are presented, to the extent feasible, that will reduce  
 11 adverse effects to levels that are not adverse or less than significant. In situations where feasible  
 12 mitigation for significant adverse effects is not identified, the effect is considered significant and  
 13 unavoidable.

### 14 **11.3.2.8 Critical Habitat and Essential Fish Habitat**

15 For federally listed species for which critical habitat has been designated, the analysis of whether  
 16 there is an adverse effect to critical habitat is included within the analysis of effects to all habitat for  
 17 the species. Prior to deciding whether to issue permits, USFWS and NMFS will undertake an analysis  
 18 of the BDCP pursuant to the Section 7 consultation process to ensure that issuance of the permits  
 19 and implementation of the BDCP is not likely to result in the destruction or adverse modification of  
 20 critical habitat.

21 The agencies will undertake an Essential Fish Habitat (EFH) consultation. More information about  
 22 critical habitat and EFH is provided in the BDCP Effects Analysis (BDCP Chapter 5 – *Effects Analysis*,  
 23 hereby incorporated by reference).

### 24 **11.3.3 Determination of Effects**

25 The covered and non-covered fish and aquatic resource species discussed above have similar life  
 26 history requirements (i.e., habitat, water quality) as all aquatic resource species in the project area.  
 27 Because there are so many aquatic species in the project area, the covered and non-covered aquatic  
 28 resource species are used as assessment species for the impact analysis. The impacts of the action  
 29 alternatives on fish and aquatic biological resources may result from construction, maintenance, and  
 30 operation of BDCP water conveyance facilities, and construction and implementation of  
 31 conservation measures. This impact analysis assumes that an action alternative would have an  
 32 impact on fish and aquatic resources if it directly or indirectly harmed or harassed individuals or  
 33 populations of the species considered in this chapter, or removed or damaged the habitat of these  
 34 species. Action alternatives that meet this initial screening threshold are then analyzed using the  
 35 criteria described below.

36 The CEQA Guidelines (Title 14, Division 6, Chapter 3 of the California Code of Regulations [CCR]), at  
 37 Section 15064.7, encourage public agencies to develop thresholds of significance to use in  
 38 determining the significance of environmental effects when complying with CEQA. In this same  
 39 section, the CEQA Guidelines define a threshold of significance as “an identifiable quantitative,  
 40 qualitative or performance level of a particular environmental effect, non-compliance with which  
 41 means the effect will normally be determined to be significant by the agency and compliance with  
 42 which means the effect normally will be determined to be less than significant.” Although Section

1 15064.7 authorizes a public agency subject to CEQA to conduct a formal public process for  
 2 formulating significance thresholds that would apply to all of the agency’s projects, the courts have  
 3 recognized that, in preparing an individual CEQA document, a lead agency may informally develop  
 4 significance criteria applicable to particular projects, provided that such criteria are supported by  
 5 substantial evidence<sup>4</sup>.

6 Here the significance criteria used to evaluate impacts on fish and aquatic resources are based on  
 7 and incorporate guidance contained in Section 1508.27 of the Council on Environmental Quality  
 8 (CEQ) NEPA regulations regarding significance determinations; the mandatory findings of  
 9 significance, as listed in Section 15065 of the State CEQA Guidelines (Title 14, Chapter 3 of the CCR);  
 10 and criteria contained in Appendix G, “Environmental Checklist Form,” of the State CEQA Guidelines.

11 Section 1508.27 of the CEQ NEPA regulations defines the word “significantly,” which comes into play  
 12 in the statutory mandate under NEPA for federal agencies to prepare Environmental Impact  
 13 Statements for major federal actions *significantly* affecting the human environment. (42 U.S.C. §  
 14 4321.) Under section 1508.27, federal agencies, in determining whether a major federal action  
 15 significantly affects the human environment, should consider both the “context” and the “intensity”  
 16 of the effects at issue. Context relates to the setting for the proposed action (i.e., whether it is  
 17 regional or local in scale). Intensity “refers to the severity of impact.” Among the factors to be  
 18 considered in assessing intensity are “[t]he degree to which the action may adversely affect an  
 19 endangered or threatened species or its habitat that has been determined to be critical under the  
 20 Endangered Species Act of 1973.”

21 In enacting CEQA, the California Legislature found and declared that it was the policy of the state,  
 22 among other things, to “[p]revent the elimination of fish or wildlife species due to man’s activities”  
 23 and “insure that fish and wildlife populations do not drop below self-perpetuating levels[.]” (Cal.  
 24 Pub. Resources Code section 21001[c]). CEQA Guidelines section 15065, which echoes this policy  
 25 statement, identified several broadly framed impact categories that often serve as significance  
 26 thresholds.

27 Similarly, the sample Initial Study Checklist found in Appendix G to the CEQA Guidelines identifies  
 28 questions lead agencies should generally ask with respect to a proposed project’s potential impacts  
 29 on Biological Resources. The impact categories from CEQA Guidelines section 15065 and the  
 30 Appendix G questions are often used to formulate more specific significance thresholds. For this  
 31 analysis impact categories from CEQA Guidelines section 15065 and the Appendix G questions have  
 32 been refined to apply to potential impacts on fish and other aquatic resources and impacts are  
 33 considered significant under CEQA or adverse under NEPA if the BDCP Alternative would

- 34 ● substantially reduce the habitat of a fish, aquatic, or wildlife species;
- 35 ● cause a fish or wildlife population to drop below self-sustaining levels;
- 36 ● threaten to eliminate a plant or animal community;
- 37 ● substantially reduce the number or restrict the range of an endangered, rare or threatened
- 38 species;

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<sup>4</sup> See, e.g., *Oakland Heritage Alliance v. City of Oakland* (2011) (2011) 195 Cal.App.4th 884,896-897; *Citizens for Responsible Equitable Environmental Development v. City of Chula Vista* (2011) 197 Cal.App.4th 327, 336.)

- 1       • have a substantial adverse effect, either directly or through habitat modifications, on any
- 2       [aquatic] species identified as a candidate, sensitive, or special status species in local or regional
- 3       plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and
- 4       Wildlife Service [or by the National Marine Fisheries Service];
- 5       • have a substantial adverse effect on any ... sensitive [aquatic] natural community identified in
- 6       local or regional plans, policies, regulations or by the California Department of Fish and Game or
- 7       US Fish and Wildlife Service; or
- 8       • interfere substantially with the movement of any native resident or migratory fish ... species.

9       These seven enumerated thresholds have been applied to all determinations of effect, adverse for  
 10       purposes of NEPA, and significant for purposes of CEQA, for each impact mechanism discussed in  
 11       the following pages. All aspects of the alternatives are subject to these criteria, including the  
 12       construction, maintenance, and operation of BDCP water conveyance facilities (CM1), and  
 13       implementation of CM2–CM22. Consistent with the impact categories in CEQA Guidelines 15065,  
 14       these thresholds are broadly framed and leave room for expert judgement and application to the  
 15       numerous aspects of the alternatives and the multiple species evaluated.

16       Each alternative is analyzed in comparison to its relevant baseline. Under the CEQA analysis, each  
 17       action alternative is compared against existing conditions at the time the NOP was prepared (State  
 18       CEQA Guidelines, section 15125[a]). Under the NEPA analysis, each action alternative is compared  
 19       against the anticipated future condition (CEQ Regulations, sections. 1502.14, 150216[d]) that would  
 20       occur under the No Action Alternative in 2060. CEQA and NEPA baselines are more fully described  
 21       in Chapter 4, Section 4.2.1.1. The NEPA baseline includes the projected climate change (changed  
 22       precipitation patterns) and sea level rise, and many other programs, projects, and policies expected  
 23       to occur by 2060, as well as the implementation of most of the required actions under both the  
 24       December 2008 USFWS BiOp and the June 2009 NMFS BiOp (e.g., inclusion of Fall X2 criteria). As a  
 25       result of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and  
 26       NEPA significance conclusions to vary between one another under the same impact discussion.  
 27       Although the NAA represents projected future conditions, the manner in which some of the required  
 28       actions under the BiOps remain uncertain at present. As a result, some of these required actions  
 29       were not incorporated, and could not be accurately incorporated, into modeling for the NAA or for  
 30       any of the action alternatives. While it is possible that the implementation of these unmodeled  
 31       actions over time could alter the resultant magnitude of effects under the implementation of BDCP  
 32       action alternatives, the unmodeled actions are intended to improve conditions for fisheries, so that  
 33       their full implementation over time should contribute to reduced adverse environmental effects and  
 34       to increased environmental benefits. Thus, the analyses contained in this EIR/EIS are considered  
 35       conservative with respect to any potential adverse environmental consequences related to the  
 36       implementation of these unmodeled actions, and likely somewhat overstate the adverse effects of  
 37       both the No Action Alternative and the proposed action alternatives. As a result, the future  
 38       conditions in 2060 will likely be more environmentally benign than is reflected in the modeling  
 39       results presented in the EIR/EIS.

40       Under CEQA, the absence of sea level rise and climate change in Existing Conditions results in  
 41       model-generated impact conclusions that include the impacts of sea level rise and climate change  
 42       with the effects of the action alternatives. As a consequence, the CEQA conclusions in many instances  
 43       either overstate the effects of the action alternatives or suggest significant effects that are largely  
 44       attributable to sea level rise and climate change, and not to the action alternatives.

1 In both sets of analyses, the Lead Agencies have relied on computer models that represent best  
 2 available science; however, any predictions of conditions 50 years from the present are inherently  
 3 limited and reflect a large degree of speculation. In the interest of informing the public of what DWR  
 4 believes to be the reasonably foreseeable impacts of the action alternatives, DWR has focused in its  
 5 CEQA analysis primarily on the contribution of the action alternatives, as opposed to the impacts of  
 6 sea level rise and climate change, in assessing the significance of the impacts of these action  
 7 alternatives. The opposite approach, which would treat the impacts of sea level rise and climate  
 8 change as though they were impacts of the action alternatives, would overestimate the effects of the  
 9 action alternatives. The approach taken here by DWR also has the effect of highlighting the  
 10 substantial nature of the consequences of sea level rise and climate change on California's water  
 11 system.

### 12 **11.3.4 Effects and Mitigation Approaches**

13 The analysis of effects of each alternative is organized by species. The effects on each species are  
 14 considered by category, as shown below.

- 15 ● Construction and Maintenance of CM1
  - 16 ○ Effects of construction of water conveyance facilities
  - 17 ○ Effects of maintenance of water conveyance facilities
- 18 ● Water Operations of CM1
  - 19 ○ Effects of water operations on entrainment
  - 20 ○ Effects of water operations on spawning habitat
  - 21 ○ Effects of water operations on rearing habitat
  - 22 ○ Effects of water operations on migration conditions
- 23 ● Restoration Measures (CM2, CM4–CM7, and CM10)
  - 24 ○ Effects of construction of restoration measures
  - 25 ○ Effects of contaminants associated with restoration measures
  - 26 ○ Effects of restored habitat conditions
- 27 ● Other Conservation Measures (CM12–CM19 and CM21)
  - 28 ○ Effects of methylmercury management (CM12)
  - 29 ○ Effects of invasive aquatic vegetation management (CM13)
  - 30 ○ Effects of dissolved oxygen level management (CM14)
  - 31 ○ Effects of localized reduction of predatory fishes (CM15)
  - 32 ○ Effects of nonphysical fish barriers (CM16)
  - 33 ○ Effects of illegal harvest reduction (CM17)
  - 34 ○ Effects of conservation hatcheries (CM18)
  - 35 ○ Effects of urban stormwater treatment (CM19)
  - 36 ○ Effects of removal/relocation of nonproject diversions (CM21).

1 The construction and operation of the BDCP action alternatives would result in a range of short-  
2 term and long-term effects on environmental conditions in the Sacramento River and the Delta. This  
3 would in turn result in a range of direct and indirect effects on fish and aquatic resources that  
4 depend on the affected habitats. The BDCP conservation measures have been designed to avoid and  
5 minimize such impacts where possible and improve habitat conditions. The project also  
6 incorporates environmental commitments which have been designed to avoid and minimize effects  
7 where possible. To the extent that effects remain, and such effects are deemed to be adverse or  
8 significant, feasible mitigation measures will be implemented to reduce effects.

#### 11.3.4.1 No Action Alternative

The No Action Alternative for the BDCP EIR/EIS means that the BDCP would not be completed and incidental take permits would not be issued. This alternative entails programs, projects, and policies by federal, state and local agencies included in Existing Conditions assumptions and those with clearly defined management and/or operational plans, including facilities under construction as of February 13, 2009. The No Action Alternative assumptions also include facilities and programs that received approvals and permits in 2009 because those programs were consistent with existing management direction as of the NOP. As the NEPA baseline, the No Action Alternative includes continuation of operations of the SWP and CVP, with through-Delta conveyance only under currently authorized operational criteria as described in the 2008 BA with operational assumptions modified by the 2008 USFWS and 2009 NMFS BiOps and other relevant plans and projects that would likely occur in the absence of BDCP actions. This also assumes implementation of the Fall X2 action, which requires additional water releases in wet and above normal years to meet salinity targets in the western Delta in September and October, plus releases in November to augment Delta outflow. The No Action Alternative scenario (NAA) takes into account sea level rise and climate change that would occur around Year 2060.

The NAA assumes compliance with the California Endangered Species Act (CESA) and the federal Endangered Species Act (ESA) will continue on a case-by-case basis for future programs and projects that have a potential to take listed species under each act. It also assumes utilization of senior water rights in the Sacramento and San Joaquin river watersheds by Year 2025 utilizing facilities currently available or under construction.

The NAA assumes continued operations of flood management facilities by the federal, state, and local agencies. It also assumes that future levee failures due to flooding, erosion, subsidence, wave action, seismic events, burrowing animals, physical encroachment (such as barge collisions), or other causes would be repaired under ongoing programs.

Existing Conditions, the CEQA baseline, are defined in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*. Briefly, Existing Conditions include the 2008 USFWS and 2009 NMFS BiOps, facilities and ongoing programs in place as of February 13, 2009, but do not include implementation of Fall X2.

A summary of the programs, plans, and projects included under the NAA and Existing Conditions, as well as detailed descriptions of these baselines, are provided in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*. The projects that could affect fish and aquatic resources are summarized here in Table 11-12, along with their anticipated effects on covered fish species (see Section 11.1.3.1) and aquatic resources.

1 **Table 11-12. Effects on Covered Fish Species from the Plans, Policies, and Programs for the No Action**  
2 **Alternative**

Agency	Program/Project	Status	Description of Program/Project	Effects on Covered Fish Species
California Department of Water Resources	FERC License Renewal for Oroville Project	Draft Water Quality Certification issued December 6, 2010 and comments on Draft received December 10, 2010. FERC license will be issued and operations will be in accordance with NMFS BiOp and final FERC license.	The renewed federal license will allow the Oroville Facilities to continue providing hydroelectric power and regulatory compliance with water supply and flood control.	No adverse effects on aquatic habitat or covered fish species are expected based upon environmental documentation for this project (California Department of Water Resources 2008).
Contra Costa Water District	Contra Costa Canal Fish Screen Project	Completed in 2011.	The project installed a fish screen at the Contra Costa Canal diversion at Rock Slough.	Beneficial effects on aquatic habitat or covered fish species are expected.
Contra Costa Water District, U.S. Bureau of Reclamation, and California Department of Water Resources	Middle River Intake and Pump Station (previously known as the Alternative Intake Project)	Completed in 2011.	The project includes a 250 cfs pump station, a screened intake structure along Victoria Canal on Victoria Island, and a pipeline across Victoria Island tunneled under Old River to the District's Old River Pump Station where it connects to existing conveyance facilities.	No adverse effects on aquatic habitat or covered fish species are expected based upon environmental documentation for this project (Contra Costa Water District 2006).
Freeport Regional Water Authority and U.S. Bureau of Reclamation	Freeport Regional Water Project	Completed in 2010.	The project includes an intake/pumping plant near Freeport on the Sacramento River and a conveyance structure to transport water through Sacramento County to the Folsom South Canal. The pumping plant diverts 185 million gallons per day.	No adverse effects on aquatic habitat or covered fish species are anticipated based upon environmental documentation for this project (Freeport Regional Water Authority 2003).
City of Stockton	Delta Water Supply Project	Completed in 2012.	This project consists of a new intake structure and pumping station adjacent to the San Joaquin River; a water treatment plant along Lower Sacramento Road; and water pipelines along Eight Mile, Davis, and Lower Sacramento Roads.	No adverse effects on surface water resources or covered fish species are anticipated based upon environmental documentation for this project (City of Stockton 2005).

Agency	Program/Project	Status	Description of Program/Project	Effects on Covered Fish Species
Reclamation District 2093	Liberty Island Conservation Bank	Completed in 2011.	The project consists of restoration of 186 acres on Liberty Island in unincorporated Yolo County. Restoration was focused on enhancing and creating tidal aquatic habitat suitable for special-status fish species (including salmon and delta smelt).	No adverse effects on aquatic habitat or covered fish species are anticipated based upon environmental documentation for this project (Bureau of Reclamation 2009).
Tehama Colusa Canal Authority and U.S. Bureau of Reclamation	Red Bluff Diversion Dam Fish Passage Project	Pumping plant and fish screen was completed in 2012. Operations of the pumping plant began September 2012. Expected decommissioning of the old structure to begin September 2013.	Proposed improvements include modifications made to upstream and downstream anadromous fish passage and water delivery to agricultural lands within CVP.	No adverse effects on aquatic habitat or covered fish species are anticipated based upon environmental documentation for this project (Bureau of Reclamation 2002).
U.S. Bureau of Reclamation and State Water Resources Control Board	Battle Creek Salmon and Steelhead Restoration Project	Construction is being implemented in three phases and is currently underway. The final phase is estimated to occur between 2013 and 2015.	This project includes modification of facilities at Battle Creek Hydroelectric Project diversion dam sites located on the North Fork Battle Creek, South Fork Battle Creek, and Baldwin Creek. Fish screens and ladders will be installed at various location; a fish barrier will be installed on Baldwin Creek; an Inskip Powerhouse tailrace connector and bypass will be installed on the South Fork; a South Powerhouse tailrace connector will be installed; and Lower Ripley Creek Feeder, Soap Creek Feeder, Coleman and South diversion dams, and appurtenant conveyance systems will be removed.	
U.S. Bureau of Reclamation, California Department of Fish and Game, and Natomas Central Mutual Water Company	American Basin Fish Screen and Habitat Improvement Project	Expected completion in 2012.	This three-phase project includes consolidation of diversion facilities; removal of decommissioned facilities; aquatic and riparian habitat restoration; and installing fish screens in the Sacramento River. Total project footprint encompasses about 124 acres east of the Yolo Bypass.	No adverse effects on aquatic habitat or covered fish species are anticipated based upon environmental documentation for this project (Bureau of Reclamation 2008c).

Agency	Program/Project	Status	Description of Program/Project	Effects on Covered Fish Species
Yolo County	General Plan Update	Adopted in November 2009.	The Yolo County general plan provides comprehensive and long-term policies for the county and determines land use planning throughout the unincorporated area.	No adverse effects on aquatic habitat or covered fish species are anticipated.
Zone 7 Water Agency and Department of Water Resources	South Bay Aqueduct Improvement and Enlargement Project	Under construction. Estimated completion in 2012.	This project includes upgrades to the South Bay Pumping Plant; raised linings on open channel sections of the aqueduct; the addition of a 450 acre-foot Dyer Reservoir; and 4.5 miles of pipeline connecting to the South Bay Pumping Plant	No adverse effects on aquatic habitat or covered fish species are anticipated based upon environmental documentation for this project (California Department of Water Resources 2004c).

1

2 **Covered Fish Species**

3 Many of the projects and programs that would occur under the No Action Alternative would be  
 4 similar to those included in the BDCP alternatives and would have similar potential effects. These  
 5 effects would also be similar between the different covered species. Therefore, the following  
 6 assessment addresses all the covered species as a group for some potential effects (e.g., water  
 7 quality effects), but addresses individual species for other mechanisms where the effects could be  
 8 measurably different among species (e.g., entrainment).

9 **Construction and Maintenance of CM1**

10 **Impact AQUA-NAA1: Effects of Construction of Facilities on Covered Fish Species**

11 Following is a summary of the potential exposure of covered fish species to impacts from  
 12 construction of other projects under NAA. Impacts include turbidity, accidental spills, disturbance of  
 13 contaminated sediment, underwater noise, fish stranding, in-water work activities, loss of spawning,  
 14 rearing or migration habitat, and predation. The construction and maintenance activities occurring  
 15 under the No Action Alternative, would have similar effects on all the covered fish species; therefore,  
 16 the analysis below is combined for all the covered species instead of analyzed by individual species.

17 **Turbidity**

18 Under the NAA, existing facilities and operations would be continued and none of the conservation  
 19 measures CM1–CM22 associated with the action alternatives would be implemented, except for any  
 20 similar programs that were approved or permitted prior to the 2009 NOP. Detailed discussions of  
 21 these programs are provided in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No*  
 22 *Project Alternative, and Cumulative Impact Conditions*. Construction and maintenance of projects or  
 23 programs under the NAA (Table 11-12), such as the Battle Creek Salmon and Steelhead Restoration  
 24 Project which would involve substantial in-channel and/or near-channel construction activities (e.g.,  
 25 dredging, dam removal), would result in the temporary generation and release of suspended  
 26 sediments to the water column, and other potential construction-related water quality effects.

1 Similarly, routine construction activities that may occur for urbanization and infrastructure to  
2 accommodate population growth would generally be anticipated to involve relatively dispersed,  
3 temporary, and intermittent land disturbances across the affected environment. Further, certain  
4 maintenance activities, such as levee repair and maintenance, could result in temporary increases in  
5 water turbidity. Erosion of disturbed soils and associated sediment load would potentially enter  
6 surface water bodies. Increased suspended sediments would temporarily increase water column  
7 turbidity, altering habitat conditions in the Plan Area for fish and other aquatic species. However,  
8 effects on fish from increases in turbidity during in- or near-water construction and maintenance  
9 activities would be minimized through adherence to applicable federal, state, and local regulations,  
10 project-specific designs, BMPs, and environmental commitments intended to avoid, prevent or  
11 minimize turbidity (e.g., implementation of site-specific erosion and sediment control plans). Each  
12 project implemented under the NAA would require its own separate environmental compliance  
13 process.

14 As described in Chapter 6, *Surface Water* water conveyance operations under the NAA (by 2060)  
15 would alter the magnitude and timing of water releases from reservoirs upstream of the Delta as  
16 well as alter downstream river flows relative to Existing Conditions (conditions that existed in  
17 February 2009) (see Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*  
18 *Alternative, and Cumulative Impact Conditions*). The changes in mean monthly average river flows  
19 under the NAA are not expected to cause river turbidity levels (highs, lows, typical conditions) to be  
20 outside the ranges occurring under Existing Conditions.

21 Delta turbidity levels are affected by turbidity levels of Delta inflows (and associated sediment load),  
22 and by fluctuations in flows within the Delta channels due to tides; sediments deposit as flow  
23 velocities and turbulence are low at periods of slack tide, and sediments become suspended when  
24 flow velocities and turbulence increase when tidal currents are near the maximum. Under the NAA,  
25 turbidity levels in the rivers contributing to Delta inflows would be similar to Existing Conditions.  
26 Finally, turbidity levels in the SWP/CVP Export Service Areas under the NAA and Existing Conditions  
27 are not expected to be different from each other. Therefore, because no significant changes in  
28 turbidity would occur under the NAA upstream of the Delta, in the Plan Area or in the SWP/CVP  
29 Export Service Areas, covered fish species would not be adversely affected by turbidity changes  
30 related to water conveyance operations under this alternative.

31 Changes in land use in the Plan Area under the NAA that would occur relative to Existing Conditions  
32 could have minor effects on turbidity throughout the affected environment. Site-specific and  
33 temporal exceptions may occur due to localized temporary construction activities, dredging,  
34 development, or other land use changes. These localized actions would generally require agency  
35 permits that would regulate and limit both their short-term and long-term effects on total  
36 suspended solids (TSS) concentrations and turbidity.

### 37 ***Accidental Spills***

38 Potential construction-related water quality effects associated with other project and program  
39 actions that may occur under the NAA, may include the inadvertent release of construction-related  
40 chemicals (e.g., fuels, solvents, and oils) and construction-related wastes (e.g., concrete, asphalt,  
41 cleaning agents, paint, and trash) to surface waters, which would result in localized water quality  
42 degradation. This could in turn result in adverse effects on covered fish species through direct injury  
43 and mortality or delayed effects on growth and survival, depending on the nature and extent of the  
44 spill and the contaminants involved. It is expected that adverse effects on fish from inadvertent

1 spills would be avoided through adherence to applicable federal, state, and local regulations,  
2 project-specific design, BMPs, and environmental commitments intended to avoid, prevent or  
3 minimize hazardous spills and other construction-related hazards and/or mitigate for such  
4 occurrences (e.g., spill prevention and control plans and hazardous materials management plans).  
5 Each project implemented under the NAA would require its own separate environmental  
6 compliance process.

### 7 ***Disturbance of Contaminated Sediments***

8 Sediment in many locations throughout the Plan Area has been contaminated by historical and  
9 current urban discharges (e.g., hydrocarbons, metals, and PCBs), agricultural runoff containing  
10 persistent pesticides (e.g., organochlorines), and mercury from historic mining. Construction and  
11 maintenance projects and programs implemented under the NAA that require disturbance of  
12 sediment (e.g., periodic channel dredging) have the potential resuspend contaminated sediments,  
13 which could result in direct and indirect effects on covered fish species. Individual fish could be  
14 directly exposed to the suspended contaminants if they are in the immediate vicinity of disturbed  
15 contaminated sediments. The potential effects of such events on covered fish species would depend  
16 on the types and concentrations of the toxicants in disturbed sediments and exposure time, and  
17 therefore cannot be predicted at this time. However, it is unlikely that covered fish species would  
18 stay in the vicinity of in-channel construction activities because most of these species are migratory  
19 and unlikely to be exposed for a prolonged period of time; the duration of these activities would also  
20 be limited. Therefore the potential for adverse effects on fish related to toxicants is minimal.  
21 Further, individual project permit restrictions on in-water work would limit activities to work  
22 windows when covered fish species are typically least abundant in the construction or maintenance  
23 area.

24 Covered fish species may also eat invertebrates that are stirred up with resuspended contaminated  
25 sediment. Any such exposures through the food chain will typically be short-term and localized so  
26 that they affect very few individual fishes. In addition, project-specific BMPs and environmental  
27 commitments would minimize the disturbance and spread of suspended sediment (e.g., employ silt  
28 curtains). Each project implemented under the NAA would require its own separate environmental  
29 compliance process. Therefore, any changes in water quality are expected to be limited in intensity,  
30 duration and extent. For these reasons, the effect would not be adverse.

### 31 ***Underwater Noise***

32 Construction of projects or programs under the NAA requiring the installation of in-channel  
33 structures where the use of pile driving is necessary (e.g., cofferdams and diversion intakes) has the  
34 potential for adverse effects on covered fish species if they are present in the vicinity of pile driving.  
35 Impact pile driving produces impulsive sound pressure waves that can damage fish organs and  
36 tissues. The effects of exposure can range from temporary hearing loss to physical injury sufficient  
37 to cause direct mortality or increased predation risks. The degree of effect is a function of the  
38 intensity of the sound, the distance from the source, the duration of exposure, the size of the fish  
39 exposed (smaller fish are more sensitive), and the species-specific sensitivity.

40 However, adverse effects on covered fish species under this alternative from pile driving would be  
41 avoided or minimized through project-specific AMMs, BMPs, environmental commitments and/or  
42 mitigation measures, which could include seasonal timing restrictions on in-water activities; the use  
43 of vibratory pile drivers when possible; the use of noise attenuation devices; and limitations on the  
44 duration of impact pile driving activities. Each project implemented under the NAA would require

1 its own separate environmental compliance process, which is expected to reduce, eliminate, or  
2 mitigate adverse effects.

### 3 ***Fish Stranding and Direct Injury***

4 In-water work activities (e.g., dredging, cofferdam installation, placement of riprap) associated with  
5 the implementation of maintenance and restoration projects under the NAA have the potential to  
6 cause take of covered fish species through direct impact from construction activities and through  
7 the process of trapping and rescuing fish from construction areas. Although most fish would likely  
8 avoid the noise and activity of in-water construction and maintenance activities, depending on the  
9 nature of the activity, its seasonal timing and duration, there could be a potential for fish (of multiple  
10 species) to be harmed, harassed, injured, or killed. However, take of fish related to construction and  
11 maintenance activities would be minimized by implementation of project-specific AMMs, BMPs,  
12 environmental commitments and/or mitigation measures, which could include seasonal timing  
13 restrictions on in-water activities, and implementation of species-specific fish rescue and salvage  
14 plans. As a result, effects are not expected to be adverse.

### 15 ***Loss of Spawning, Rearing, or Migration Habitat***

16 In-water construction and maintenance activities of programs and projects implemented under the  
17 NAA (e.g., levee repair, "OCAP" related restoration projects) could temporarily or permanently alter  
18 habitat conditions for covered fish species in the vicinity of these activities and thereby adversely  
19 affect spawning, rearing and/or migration habitat. For example, any activities that occurs in a  
20 species' migration corridor have the potential to affect species behavior (i.e., through a change in  
21 migration route within the channel, delay from a noise deterrent, artificial light sources, etc.).  
22 Cofferdams used during in-water construction to isolate the work areas, temporarily reduce the area  
23 of habitat available to fish for migration and rearing. Further, in-water maintenance activities such  
24 as dredging and riprap placement can reduce habitat suitability. For example, dredging decreases  
25 the number of macroinvertebrates in the dredged area, which can cause a temporary loss of prey  
26 resources for benthic feeders such as splittail, green sturgeon, and juvenile Chinook salmon.

27 The fish species affected and the severity or magnitude of any negative effects on spawning, rearing  
28 or migration habitat would depend on several factors including the seasonal timing of the activity,  
29 the suitability and/or quality of the habitat to begin with, and the quantity of habitat disturbed or  
30 permanently altered. As indicated above, for other in-water construction factors, effects are not  
31 expected to be adverse due to the implementation of project-specific AMMs, BMPs, environmental  
32 commitments and/or mitigation measures, which could include seasonal timing restrictions on in-  
33 water activities, and implementation of species-specific fish rescue and salvage plans. Each project  
34 implemented under the NAA would require its own separate environmental compliance process. As  
35 a result, it is assumed that appropriate mitigation would be implemented and effects would not be  
36 adverse.

### 37 ***Predation***

38 Programs and projects implemented under the NAA that involve the construction of in- and over-  
39 water structures (e.g., docks and associated pilings) could potentially result in increased predation  
40 on covered fish species relative to Existing Conditions. These types of structures can provide  
41 suitable predator habitat by providing shade and cover for predatory fishes, and perching areas for  
42 piscivorous birds.

1 Predation loss at the SWP/CVP south Delta facilities is assumed to be proportional to entrainment  
2 loss for covered fish species. In addition, the CCF has a large population of striped bass and other  
3 predator fish (Brown et al. 1996), and these predators are estimated to consume approximately  
4 75% or more, of the prey fish entrained into the CCF (Gingras 1997; Clark et al. 2009; Castillo et al.  
5 2012). Average pre-screen predation loss varies according to species, time of year, and pumping  
6 rate.

7 In the Plan Area ecosystem, predation rates on covered fish species are expected to increase under  
8 NAA due to the expected continued spread of nonnative species (Moyle and Bennett 2008), as well  
9 as invasive aquatic plants, such as water hyacinth and *Egeria* (Santos et al. 2011), and other  
10 projected environmental trends that are expected to decrease native fish habitat suitability over  
11 time (Brown et al. 2013). Non-native aquatic vegetation provides habitat for non-native predators,  
12 such as bass and sunfish, which can prey on and otherwise exclude native fish species; it also  
13 increases water clarity which can improve foraging efficiency of all visual predators. Specifically,  
14 *Egeria* is thought to reduce turbidity through a reduction in water velocity, which has been  
15 hypothesized to increase predation rates on some native fish (Brown and Michniuk 2007). However,  
16 the effect of increased predation rates on covered fish species at the population level is uncertain (in  
17 *Appendix 5F Biological Stressors, Section F.5.1 Fish Predation*).

18 Under NAA, improvements and programs implemented at the SWP/CVP south Delta facilities as per  
19 NMFS (2009) are expected to reduce site-specific predation levels. This will include modifications to  
20 the collection facilities and the release procedures for fish salvaged at these facilities. Improvements  
21 are also expected to occur at temporary diversion structures, to minimize attracting predator  
22 species. In addition, the expected amount of in-water and overwater structures likely to be  
23 permitted would be small compared to the overall habitat occurring in the Plan Area. Therefore, the  
24 effect would not be adverse.

25 **NEPA Effects:** Overall, the potential impact mechanisms on covered fish species from construction of  
26 other projects under NAA would include effects from increased turbidity, accidental spills,  
27 disturbance of contaminated sediment, underwater noise, fish stranding, in-water work activities,  
28 loss of spawning, rearing or migration habitat, and predation. However, as described above, these  
29 effects would not be adverse because of the limited extent, intensity, and duration of expected  
30 construction and maintenance projects in the Plan Area. In addition, any such construction projects  
31 would be subject to a separate environmental compliance process, with permit stipulations which  
32 would include the implementation of project-specific AMMs, BMPs, environmental commitments  
33 and/or mitigation measures. This would include project-specific erosion and sediment control  
34 plans; hazardous materials management plans; SWPPPs; spill prevention and control plans; and  
35 limiting in-water activities to periods of low flow and/or to times when covered fish species are not  
36 likely to be present. Therefore, the effects of construction projects on covered fish species would not  
37 be expected to be adverse, and no additional mitigation would be required. However, if the effects  
38 were determined to be adverse, it is assumed that appropriate mitigation would be implemented.

39 **CEQA Conclusion:** For any projects implemented under the NAA that include in-water construction  
40 and maintenance activities, there would be the potential to stress, injure, or kill covered fish species  
41 through direct or indirect effects, and the potential to alter spawning, rearing and/or migration  
42 habitat of covered fish species through direct loss or modification. However, such projects would be  
43 subject to specific environmental permitting processes, which would minimize potential effects  
44 through the implementation of project-specific AMMs, BMPs, environmental commitments and/or

1 mitigation measures. Thus, the construction-related effects under the NAA would be less than  
2 significant, and no additional mitigation would be required.

### 3 **Impact AQUA-NAA2: Effects of Maintenance of Facilities on Covered Fish Species**

4 **NEPA Effects:** The discussion of maintenance activity effects are provided above with the  
5 construction effects (Impact AQUA-NAA1), and the conclusions would also not be adverse.

6 **CEQA Conclusion:** The conclusion provided above for the construction activity effects (Impact  
7 AQUA-NAA1), would typically be very similar to those expected to occur during maintenance  
8 activities, and conclusions would also not be significant.

### 9 **Water Operations of CM1**

#### 10 **Impact AQUA-NAA3: Effects of Water Operations on Entrainment of Covered Fish Species**

11 Numerous methods were used to estimate entrainment losses under NAA, and a complete analysis  
12 can be found in the *BDCP Effects Analysis – Appendix B, Entrainment, Section B.5 – Methods of*  
13 *Biological Analysis and Section B.6 – Results (hereby incorporated by reference).*

#### 14 **Delta Smelt**

15 Simulations of entrainment for baseline conditions differ depending on the time period modeled  
16 because the climate change scenarios change operations somewhat. However, the average annual  
17 proportion of the delta smelt population lost to entrainment at the south Delta facilities under  
18 Existing Conditions, increased under model simulations of future conditions (NAA), most notably in  
19 wet, above-normal and below-normal water years. This proportional entrainment loss reflects  
20 differences attributable to simulated differences in south Delta export pumping (which influences  
21 OMR flows) and Delta outflows (which influences Fall X2). Despite these modeled increases in  
22 entrainment, the differences are not expected to reach the level of adverse effects on delta smelt  
23 populations (less than 5% of the population), primarily due to the implementation of restrictions  
24 implemented as part of the USFWS 2008 BiOp and the NMFS 2009 BiOp, and continued  
25 improvements in water export and fish salvage operations at the south Delta facilities, as well as  
26 efforts to divert delta smelt from exposure to these facilities. Overall the effect would not be adverse.

27 Delta smelt are also entrained at agricultural and waterfowl management diversions in the Plan  
28 Area (Pickard et al. 1982; Cook and Buffaloe 1998; Nobriga et al. 2004). Water export operations  
29 (through their effects on Delta flow and residence time) may also affect delta smelt entrainment in  
30 irrigation diversions (Kimmerer and Nobriga 2008), although Delta smelt are not considered highly  
31 vulnerable to entrainment at Delta agricultural diversions (Nobriga and Herbold 2009; Nobriga et al.  
32 2004).

33 **NEPA Effects:** As indicated above, despite the modeled increases in entrainment, the differences are  
34 not expected to reach the level of adverse effects on delta smelt populations (less than 5% of the  
35 population). This is primarily due to the compliance with the USFWS 2008 BiOp and the NMFS 2009  
36 BiOp, and continued improvements in water export processes, fish screens, and fish salvage  
37 operations at the south Delta facilities. Therefore, the effect would not be adverse.

38 **CEQA Conclusion:** Implementation of south Delta export pumping restrictions under the USFWS  
39 (2008) BiOp has considerably limited entrainment loss of adult delta smelt. This would continue  
40 into the future, under the No Action Alternative. Along with other improvements in SWP/CVP

1 facilities and operations expected to occur in the future, the effect would be less than significant and  
2 no mitigation would be required.

### 3 **Longfin Smelt**

4 Entrainment at the SWP and CVP facilities is not believed to be an important stressor influencing the  
5 survival of longfin smelt larvae. However, if entrainment were to be a problem for longfin smelt, its  
6 effect would be seen in dry years when recruitment is expected to be lower relative to wet years.  
7 Consequently, the population-level impact of this stressor on longfin smelt larvae is believed to be  
8 low. Further, entrainment of longfin smelt is expected to remain low, primarily due to the  
9 restrictions implemented as part of the USFWS 2008 BiOp and the NMFS 2009 BiOp, as modeled in  
10 the NAA. Overall the effect of entrainment would not be adverse.

11 Longfin smelt are also entrained at agricultural and waterfowl management diversions in the Plan  
12 Area (Pickard et al. 1982; Cook and Buffaloe 1998; Nobriga et al. 2004; Enos et al. 2007), and water  
13 export operations, through their effect on Delta flow and residence time may affect longfin smelt  
14 entrainment in irrigation diversions (Kimmerer and Nobriga 2008). Longfin smelt are not  
15 considered highly vulnerable to entrainment in Delta agricultural diversions.

16 **NEPA Effects:** Under the NAA, entrainment would be reduced by continued efforts to screen these  
17 intakes. Therefore, the effect would not be adverse.

18 **CEQA Conclusion:** Operational activities associated with water exports from SWP/CVP south Delta  
19 facilities during the NAA period, would not result in an overall substantial increase in entrainment  
20 for longfin smelt under most circumstances. Improvements in water export and fish salvage  
21 operations as a result on on-going studies, the implementation of the USFWS 2008 BiOp (U.S. Fish  
22 and Wildlife Service 2008) and actions taken by the water project operators in accordance with this  
23 BiOp are expected to result in an overall beneficial effect. Consequently, no mitigation would be  
24 required.

### 25 **Chinook Salmon**

26 Four races of Chinook salmon can occur in the Plan Area: Sacramento winter, spring, fall, and late  
27 fall-run ESUs. Each of these Chinook salmon races uses the Delta as migratory and rearing habitat  
28 during their respective life histories, implying that they would be subject to a similar range of effects  
29 from water export operations. Although the duration, extent, and timing of occurrence in the lower  
30 Sacramento River and the Delta varies between these races, and they would be subject to different  
31 stressor exposures and degree of potential effects, the mechanisms of effect would be very similar.

#### 32 **Winter-Run Chinook Salmon**

33 Under baseline conditions, losses of juvenile winter-run Chinook salmon begin in December and  
34 climb to peaks in March at both facilities, before sharply declining in April. In general, entrainment  
35 losses of winter-run Chinook salmon, as estimated by the salvage density method, were  
36 approximately five to 10 times greater at the SWP facility than those estimated for the CVP export  
37 facility. Estimated annual losses at SWP across all water years averaged approximately 6,000 fish,  
38 while the annual average loss at CVP was approximately 830–860 fish under baseline. Only a small  
39 proportion of the population would be lost to entrainment based on the simplified assumption that  
40 the annual number of winter-run Chinook salmon juveniles approaching the Delta is 500,000 fish.  
41 Proportional losses averaged across all years were 1.4% under NAA.

1 **Spring-Run Chinook Salmon**

2 In general, estimated losses of spring-run Chinook salmon at the SWP facility were approximately  
3 two to three times greater than those estimated for the CVP export facility. Estimated annual losses  
4 at SWP across all water years averaged approximately 22,000–24,000 juvenile spring-run Chinook  
5 salmon under baseline; for the CVP, the annual average loss was approximately 15,000 fish under  
6 baseline conditions. Losses were greatest in wet years (>40,000 fish) and lowest in below-normal  
7 years (1,000–5,000 fish) at both facilities under baseline conditions. The estimated percentage of  
8 juvenile spring-run Chinook salmon salvaged at the SWP/CVP south Delta export facilities averaged  
9 approximately 0.06–0.10% for baseline scenarios. Under the assumption that the annual number of  
10 juvenile spring-run Chinook salmon juveniles approaching the Delta was 750,000 fish, the  
11 percentage of the population lost to entrainment across all years averaged approximately 5.0–5.3%  
12 under baseline scenarios. However, genetic testing indicates that many fall-run juveniles are  
13 misidentified as spring-run based on the length-at-date criteria that are currently used to assign run  
14 origin of juveniles salvaged at the export facilities (Harvey pers. comm.). As with winter-run Chinook  
15 salmon, the estimates of salvage from the Delta Passage Model were considerably less than the  
16 entrainment loss estimates from the salvage density method, even accounting for losses not  
17 included in the Delta Passage Model estimates.

18 **Fall- and Late-Fall Run Chinook Salmon**

19 As noted above for juvenile spring-run Chinook salmon, the seasonal entrainment pattern is the best  
20 index of entrainment—as opposed to the actual numbers of fish—because of the overlap between  
21 juvenile fall- and spring-run Chinook salmon and the length-at-date criteria used to characterize  
22 race. Entrainment loss of fall-run Chinook salmon peaks in May at both the SWP and CVP facilities,  
23 with a second similar peak in February at the CVP facility.

24 In general, estimated losses of fall-run Chinook salmon were approximately 1.5 to three times  
25 greater at the SWP export facility compared to the CVP export facility. Estimated losses of late fall-  
26 run Chinook salmon varied between the two facilities, with entrainment loss at the CVP generally  
27 being lower than at the SWP, but not in all water-year types.

28 For fall-run Chinook salmon, estimated annual losses at the SWP across all water years averaged  
29 approximately 36,000 fish, and approximately 19,000 fish at the CVP, under baseline conditions.  
30 Losses of fall-run Chinook salmon were greatest in wet years (77,000–82,000 fish at SWP; 50,000  
31 fish at CVP), and lowest in below-normal years at the SWP (8,000 fish) and in dry years at the CVP  
32 (2,500–2,700 fish) under baseline conditions.

33 For late fall-run Chinook salmon, estimated annual losses averaged across all water years at the  
34 SWP and CVP facilities were nearly 900 and 1,000 fish, respectively under baseline scenarios.  
35 Entrainment losses of late fall-run Chinook salmon were greatest in wet years (SWP: 2,600–2,800  
36 fish); CVP: 3,200–3,400 fish) under baseline conditions. Entrainment losses in other water-year  
37 types were one or two orders of magnitude lower than in wet years.

38 Under the assumption that the annual number of juvenile fall-run Chinook salmon approaching the  
39 Delta was 23 million fish, the percentage of the population lost to entrainment across all years  
40 averaged 0.24% under baseline scenarios. The percentage of all juveniles lost to entrainment was  
41 greatest in wet years (0.6%). The percentage of fall-run and late fall-run Chinook salmon estimated  
42 to be lost to entrainment from the salvage density method was well below 1%, and the estimated  
43 salvage from the Delta Passage Model for Sacramento River-origin fish was also very low (below

1 0.1%). The estimated salvage of San Joaquin–origin fall-run Chinook salmon was above 1% for  
2 baseline conditions, reflecting the greater likelihood of fish from the San Joaquin watershed  
3 reaching the south Delta export facilities than the Sacramento River–origin fish.

4 **NEPA Effects:** General improvements implemented during the NAA timeframe are expected to  
5 reduce entrainment losses of Chinook salmon through the implementation of the NMFS and USFWS  
6 BiOp requirements (National Marine Fisheries Service 2009a; U.S. Fish and Wildlife Service 2008),  
7 particularly the reduced reverse OMR flow criteria and actions taken by the water project operators  
8 in accordance with this BiOp. The improvements expected to occur in the rate of entrainment at the  
9 SWP/CVP south Delta facilities, under NAA are likely to be generally beneficial, and would not be  
10 adverse to Chinook salmon.

11 **CEQA Conclusion:** General on-going improvements implemented under Existing Conditions during  
12 the NAA timeframe are expected to reduce entrainment losses of Chinook salmon through the  
13 implementation of the NMFS and USFWS BiOp requirements (National Marine Fisheries Service  
14 2009a; U.S. Fish and Wildlife Service 2008), particularly the reverse OMR flow criteria, court-  
15 ordered restrictions on water operations, and actions taken by the water project operators in  
16 accordance with this BiOp. Therefore, the overall effects for the NAA period are expected to be less  
17 than significant, and likely to be generally beneficial. Consequently, no mitigation would be  
18 necessary.

## 19 **Steelhead**

20 Under baseline conditions, entrainment peaks in February at both SWP and CVP facilities and is also  
21 relatively high in January and March. Estimated entrainment losses for juvenile steelhead were  
22 approximately four times greater at the SWP export facilities compared to the CVP export facilities,  
23 with losses at both facilities, due to entrainment, generally from 1,000 to 10,000 fish per year.  
24 Losses were greatest in above-normal and below-normal years, and least in critical water years.  
25 However, on-going and future operational improvements at the SWP and CVP south Delta facilities  
26 would likely result in a general decrease in entrainment for juvenile steelhead under NAA.

27 **NEPA Effects:** Consequently, the effect would likely be slightly beneficial, and would not be adverse.

28 **CEQA Conclusion:** On-going and future operational improvements at the SWP and CVP south Delta  
29 facilities would likely result in a general decrease in entrainment for juvenile steelhead under NAA.  
30 Potential impacts of the No Action Alternative on entrainment of steelhead could be slightly  
31 beneficial, and no mitigation would be required.

## 32 **Sacramento Splittail**

33 The methods used to estimate juvenile splittail entrainment were designed to account for the very  
34 large effect of Sacramento splittail abundance on entrainment (detailed in *Appendix 5B Entrainment*,  
35 *Section B.5.4.5*), and the bulk of salvage occurs in wet years. Across all water years, May–July salvage  
36 of juvenile Sacramento splittail was generally several times higher at the CVP facilities than the SWP  
37 facilities, with the differences in salvage estimates between the facilities diminishing with lower  
38 Delta inflow.

39 **NEPA Effects:** Overall, the effects of the No Action Alternative on Sacramento splittail entrainment in  
40 the NAA period are not expected to be adverse, and may be somewhat beneficial due to on-going  
41 structural and operational improvements at the south Delta export facilities.

1 **CEQA Conclusion:** Structural and operational changes associated with water exports from SWP/CVP  
2 south Delta facilities are not expected to result in an overall increase in per capita entrainment for  
3 Sacramento splittail in the NAA, and could be somewhat beneficial. Therefore, impacts of the No  
4 Action Alternative on entrainment are considered less than significant, and no mitigation would be  
5 required.

## 6 **Sturgeon**

7 Available information on the distribution and abundance of sturgeon in the Plan Area is provided in  
8 Appendix 11A, *Covered Fish Species Descriptions*. Total annual average baseline salvage of juvenile  
9 green sturgeon at the SWP south delta facilities was estimated at approximately 70 fish while  
10 baseline salvage levels at the CVP ranged from 37 to 45 green sturgeon. Total annual average  
11 salvage of juvenile white sturgeon at the SWP was estimated to be somewhat higher at 135–160 fish  
12 under baseline scenarios, and from 110 to 130 fish at the CVP.

13 Structural and operational changes associated with water exports from south SWP/CVP facilities are  
14 expected to continue to improve over time, as more information is obtained from studies regularly  
15 conducted in the area regarding the fish behavior, project operations, and entrainment. This  
16 information, and any resulting structural and operational changes, are expected to result in a slight  
17 decrease in entrainment of white and green sturgeon.

18 **NEPA Effects:** Based on available information, overall entrainment effects on sturgeon, at the south  
19 Delta water export facilities are not expected to substantially change under the NAA. Consequently,  
20 the effect would not be adverse.

21 **CEQA Conclusion:** As described above, structural and operational changes associated with water  
22 exports from south SWP/CVP facilities are not expected to substantially change the entrainment of  
23 sturgeon in the NAA, based on continued improvements implemented under the 2009 NMFS and  
24 2008 USFWS BiOps. Overall, impacts of water operations on sturgeon entrainment would be less  
25 than significant and no mitigation would be required.

## 26 **Lamprey**

27 Although somewhat limited, the available information on the distribution and abundance of lamprey  
28 in the Plan Area is provided in Appendix 11A, *Covered Fish Species Descriptions*. The analysis for  
29 Pacific and river lamprey was combined because the CVP and SWP fish salvage facilities do not  
30 distinguish between the two species. Estimated average expanded salvage densities of lamprey for  
31 each month as reported by the facilities during water years 1996–2009 used in this analysis reflect  
32 historical expanded salvage density data. Estimated average expanded salvage under baseline  
33 scenarios (all time periods) ranged from zero in September at the SWP to more than 1,300 at the  
34 CVP in January, for average annual totals of approximately 720–740 lamprey at the SWP and 2,600  
35 lamprey at the CVP.

36 **NEPA Effects:** Based on available information, overall entrainment effects on lamprey populations  
37 are not expected to substantially change under the NAA. Therefore it is anticipated that there will  
38 not be an adverse effect on lamprey.

39 **CEQA Conclusion:** As described above, structural and operational activities associated with water  
40 exports from south SWP/CVP facilities are not expected to substantially change entrainment of  
41 lamprey through the NAA period. Overall, the impacts of water operations to Pacific and river  
42 lamprey are considered less than significant, and no mitigation is required.

1 **Impact AQUA-NAA4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Covered Fish Species**

3 Water operations in the NAA are not expected to substantially or consistently affect spawning  
4 habitat for most covered fish species. Upstream of the Delta, flows could be affected by changes in  
5 water storage volumes associated with meeting the Fall X2 targets included in the USFWS BiOp.  
6 Such changes could affect upstream spawning conditions for some covered fish species.

7 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the  
8 May through September winter-run Chinook salmon spawning and egg incubation period. Although  
9 results of various analyses did not show appreciable differences for winter-run Chinook salmon. The  
10 other Chinook salmon populations typically spawn in tributaries—in which spawning habitat and  
11 egg mortality would not be substantially affected by the project operations.

12 Reduced summer flows could affect green sturgeon spawning conditions in some water years and  
13 could have the potential to increase exposure of a number of other covered fish species to their  
14 respective upper temperature thresholds.

15 **NEPA Effects:** The effect of the NAA operations on delta smelt, longfin smelt, and Sacramento  
16 splittail spawning habitat is not adverse, because there would be little change spawning conditions  
17 that the Project can influence under NAA. Longfin smelt spawning flows would be slightly reduced  
18 by 2% relative to Existing Conditions when climate change effects are accounted for (NAA), but not  
19 to an adverse level. Decreased summer flows could adversely affect spawning habitat and egg  
20 survival for some covered fish species, such as winter-run Chinook salmon and green sturgeon,  
21 although no major or consistent impacts were found on upstream spawning and egg incubation  
22 habitat conditions. Consequently, impacts on spawning and incubation for the covered species are  
23 considered less than significant.

24 **CEQA Conclusion:** As described above, operations under NAA would be similar to Existing  
25 Conditions, and would typically have no biologically meaningful effect on spawning habitat of most  
26 covered fish species. However, Shasta Reservoir storage volume at the end of May would be lower  
27 than storage volume under Existing Conditions in below normal, dry, and critical water years,  
28 indicating a small-to-moderate impact from summer water flows and temperatures. These  
29 conditions could affect spawning habitat and egg survival for some covered fish species, such as  
30 winter-run Chinook salmon and green sturgeon, although no major or consistent effects were  
31 identified. The effect could be significant for sturgeon over the NAA period. No other major or  
32 consistent significant impacts were found on upstream spawning and egg incubation habitat  
33 conditions for other covered fish species. Consequently, overall, impacts for these other covered  
34 species are considered less than significant.

35 **Impact AQUA-NAA5: Effects of Water Operations on Rearing Habitat for Covered Fish Species**

36 The SWP/CVP operations are managed to meet instream flow requirements, water rights  
37 agreements, and refuge water supply agreements in the Sacramento and San Joaquin Valleys. Water  
38 supplies are provided in a consistent manner under Existing Conditions, and this would be expected  
39 to continue into the future under the NAA. However, the NAA includes sea level rise and other  
40 anticipated climate changes, as well as expected increase in water rights demands, implementation  
41 of facilities currently under construction, and on-going implementation of Fall X2 criteria, all of  
42 which affect operations relative to current conditions. Detailed discussions of what is included in the  
43 NAA are provided in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*

1 *Alternative, and Cumulative Impact Conditions.* Operations to meet Fall X2 criteria would require  
2 release of water from the SWP/CVP reservoirs in the fall of wet and above-normal years to increase  
3 Delta outflow, which would increase rearing habitat in the Delta in the fall, but would also likely  
4 reduce flows (and rearing habitat) at other times of the year. Habitat suitability would also decrease  
5 slightly over time, because of anticipated increases in summer-early fall air (and thus water)  
6 temperatures associated with climate change. Changes in temperature and salinity, due to sea level  
7 rise and climate change, and associated operational responses, are expected to alter the distribution  
8 of covered fish species, based on behavioral responses of the fish to these stressors.

9 Lower summer flows in some areas are expected to affect rearing conditions for most, if not all  
10 covered fish species, somewhere in the system. For example, reduced summer flows would have the  
11 potential to reduce the quality and quantity of rearing habitat for the covered fish species, such as  
12 spring- and fall-run Chinook salmon and green sturgeon in the Feather River, and delta smelt,  
13 sturgeon and splittail in the estuary. In tributary streams, lower summer flows may increase the  
14 frequency of water temperatures exceeding the upper tolerance thresholds for some species. Thus,  
15 the effect of lower summer river flows could be adverse for covered fishes under the NAA  
16 operations relative to Existing Conditions.

17 Under the No Action Alternative, peak monthly flows into the Yolo Bypass at Fremont Weir would be  
18 less than under Existing Conditions and less than the Yolo Bypass capacity of 343,000 cfs at Fremont  
19 Weir. This would result in a reduction in the rearing habitat in the Yolo Bypass, particularly for  
20 salmon populations, as well as a reduced spawning habitat for Sacramento splittail. As a result, the  
21 availability and quality of tributary stream and Delta floodplain rearing habitat would likely be  
22 reduced in the NAA, relative to Existing Conditions; Delta outflows would also be reduced, relative to  
23 Existing Conditions.

24 **NEPA Effects:** While these reductions could be greater than 5%, compared to the overall available  
25 habitat in the Plan Area, the loss of this restored habitat is not expected to be adverse for the  
26 covered fish species.

27 **CEQA Conclusion:** The abiotic habitat index would be increased in all water years through the NAA  
28 period, compared to Existing Conditions, even without habitat restoration. Upstream flows would  
29 also be generally similar to, or greater than, flows under Existing Conditions throughout most  
30 months and water flow years, although some reductions are expected. For example, reduced  
31 summer flows would affect rearing habitat conditions for winter-run Chinook salmon, and green  
32 and white sturgeon, which would include increased water temperatures, and could result in  
33 decreased survival over the NAA period. The effect could be significant for these covered species  
34 over the NAA period. The overall effects of the No Action Alternative would be less than significant  
35 for the other covered fish species.

### 36 **Impact AQUA-NAA6: Effects of Water Operations on Migration Habitat for Covered Fish** 37 **Species**

38 Reverse flow conditions for Old and Middle River flows on a long-term average basis under NAA  
39 would be similar to Existing Conditions, except in September through November. During wet and  
40 above-normal years, fall flows in Old and Middle River could be more positive due to compliance  
41 with Fall X2, which may reduce water diversion rates at the SWP/CVP south Delta intakes during  
42 September-November. This is expected to benefit fall-run Chinook salmon migration conditions by  
43 providing improved olfactory cues, thereby potentially reducing straying.

1 Changes in water operations under the No Action Alternative would typically result in lower  
2 summer flows, compared to Existing Conditions, although such changes would be largely due to the  
3 overall effects of climate change on upstream reservoir management. This would affect migration  
4 conditions for some covered fish species, particularly juvenile winter-run Chinook and green  
5 sturgeon.

6 The No Action Alternative would not affect the first flush of winter precipitation and the turbidity  
7 cues associated with adult delta smelt, long-fin smelt, splittail, and steelhead migration. In-Delta  
8 water temperatures would change only slightly due to flow changes, because the water  
9 temperatures are in thermal equilibrium with atmospheric conditions and not strongly influenced  
10 by flows. Therefore, there would be no substantial change in the number of stressful or lethal  
11 temperature days, due to the expected flow changes.

12 Mean monthly flows at Rio Vista under the No Action Alternative through most of the fall through  
13 spring period, averaged across all years, would be limited (<10% difference) from those under  
14 Existing Conditions, but up to 28% lower than Existing Conditions in drier water year types.

15 **NEPA Effects:** The proportion of Sacramento River flows in the Delta under the No Action  
16 Alternative would be similar to Existing Conditions, and represent 57-66% of Delta outflows. This is  
17 not expected to adversely affect migration conditions or olfactory cues for the covered fish species.

18 **CEQA Conclusion:** As described above, operations under the No Action Alternative would not  
19 substantially alter the turbidity cues associated with winter flush events that may initiate migration,  
20 nor would there be appreciable changes in water temperatures. Consequently, the impact on adult  
21 delta smelt migration conditions would be less than significant, and no mitigation is required.  
22 Average Delta outflow would be similar to Existing Conditions during the majority of the winter and  
23 spring, which would have limited effects on migration and survival of covered fish species migrating  
24 downstream in the spring.

## 25 **Restoration Measures (CM2, CM4–CM7, and CM10)**

### 26 **Impact AQUA-NAA7: Effects of Habitat Restoration on Covered Fish Species**

27 Under the No Action Alternative, the assumption is that no large-scale, long-term comprehensive  
28 habitat restoration program would occur. Tidal wetland restoration would continue to occur on a  
29 much smaller scale throughout the Delta. For example, 8,000 acres of tidal wetland restoration  
30 would occur as required by the USFWS BiOp. Small amounts of freshwater wetland and riparian  
31 woodland restoration are also likely to occur as part of voluntary restoration efforts or as mitigation  
32 for small projects under the No Action Alternative.

33 Restoration activities from various programs in the region would occur, and although the extent of  
34 these activities would typically be limited they would likely include enhancing existing habitat,  
35 breaching levees and converting agricultural and other upland areas to tidal, shallow water, open  
36 water, and floodplain habitats, as well as enhancement of channel margin habitat.

37 The construction of these restoration measures under the No Action Alternative is likely to result in  
38 a range of effects similar to those described above for construction and maintenance of the projects  
39 and programs under the No Action Alternative (see Impact AQUA-1). Such in-water and shoreline  
40 restoration measures may result in short-term adverse effects on the covered species through direct  
41 disturbance of contaminated soils and sediments, short-term water quality impacts, or increased  
42 exposure to contaminants, especially methylmercury, but the overall effects on covered fish species

1 are expected to be localized and of low magnitude. It is assumed that these effects would be  
2 minimized by limiting in-water restoration activities to the approved in-water construction window,  
3 when the least numbers of covered species would typically be present in or near the restoration  
4 sites, and other environmental permit stipulations. These would include the implementation of the  
5 environmental commitments, such as erosion and sediment control plans, hazardous materials  
6 management plans, spill prevention, containment and countermeasure plans, and SWPPPs. As a  
7 result, the effects of short-term restoration activities would likely not be adverse to the covered fish  
8 species, relative to Existing Conditions.

9 **NEPA Effects:** The No Action Alternative assumes that no large-scale reserve system that would  
10 protect and link a wide diversity of natural communities and habitat for native and covered species  
11 would occur. The No Action Alternative also does not include a comprehensive long-term  
12 management and monitoring program to ensure the continued maintenance and improvement of  
13 natural communities and native species habitat. Small amounts of habitat protection would occur  
14 under the No Action Alternative associated with mitigation for specific projects.

15 **CEQA Conclusion:** As described above, the No Action Alternative assumes that no long-term, large-  
16 scale comprehensive habitat restoration program would occur, to restore habitat functions in the  
17 Plan Area, and benefit the covered fish species. Although conservation measures on a smaller-scale,  
18 and over shorter time periods would continue to occur into the future, it is expected that there  
19 would be no comprehensive monitoring program, or adaptive management process to ensure that  
20 these actions were providing a net improvement over Existing Conditions, or providing a benefit to  
21 the species. Despite these uncertainties, the effects would be less than significant.

## 22 **Other Conservation Measures (CM12–CM19 and CM21)**

### 23 **Impact AQUA-NAA8: Effects of Other Conservation Measures on Covered Fish Species**

24 As indicated above, the No Action Alternative would not likely provide a long-term comprehensive  
25 program to address other stressors on the covered fish, although some existing and future  
26 conservation measures are anticipated to occur into the future under the No Action Alternative. For  
27 example, the Department of Boating and Waterways would continue to control IAV, and DWR will  
28 continue to implement the Watercraft Inspection Program to reduce the spread of IAV and invasive  
29 bivalves. Similarly, DWR is expected to continue to install some non-physical fish barriers to try to  
30 increase survival of salmonids migrating through the Delta. Predator control measures are also  
31 expected to be implemented on a limited basis. CDFW will also continue to conduct warden patrols  
32 within the Plan Area, to reduce illegal harvest of the covered fish species. Lastly, the existing  
33 University of California, Davis conservation hatchery would continue to operate, but the proposed  
34 expansion plan under the BDCP (*CM18, Conservation Hatcheries*) would be uncertain to occur.

35 All major urban centers in the Delta, including Sacramento, Stockton, and Tracy, and multiple  
36 smaller cities will continue to comply with National Pollutant Discharge Elimination System  
37 (NPDES) MS4 permits to develop and implement stormwater management plans or programs with  
38 the goal of reducing the discharge of pollutants under the Clean Water Act (CWA).

39 Upgrades to existing nonproject diversions to reduce entrainment of covered fish species, and their  
40 prey, are also expected to continue to occur over time. There are currently over 2,000 nonproject  
41 diversions in the Plan Area, used primarily for diverting water for agriculture, and about 95% of  
42 these diversions are unscreened (Herren and Kawasaki 2001). Currently, Reclamation's  
43 Anadromous Fish Screen Program and CDFW's Fish Screen and Passage Program are available to

1 redesign and/or screen nonproject diversions, and have implemented over 30 projects in recent  
2 years throughout the Central Valley. These programs primarily focus on the protection of  
3 anadromous salmonids, so protection for other covered fish species may be limited.

4 **NEPA Effects:** The conservation measures anticipated to occur under NAA are intended to reduce  
5 stressors to covered species, so they are expected to have neutral or beneficial effects. Therefore, the  
6 overall effects would be beneficial, relative to Existing Conditions.

7 **CEQA Conclusion:** As indicated above, the conservation measures currently being implemented in  
8 the Plan Area are expected to continue into the future, under the NAA, and are expected to be  
9 beneficial. Therefore, the effect would be less than significant.

## 10 **Non-Covered Fish Species of Primary Concern**

### 11 **Construction and Maintenance**

12 The construction and maintenance activities occurring under the No Action Alternative, would have  
13 similar effects on the non-covered fish species, as those discussed above for the covered fish species.  
14 These effects would also be similar for all non-covered species; therefore, the analysis below is  
15 combined for all non-covered species instead of analyzed by individual species.

### 16 **Impact AQUA-NAA9: Effects of Construction of Facilities on Non-Covered Fish Species**

17 The effects described for the covered fish species in Impact AQUA-NAA1 would be similar in type,  
18 duration and magnitude to those expected for the non-covered species (e.g., turbidity, accidental  
19 spills, disturbance of contaminated sediment, underwater noise, fish stranding, in-water work  
20 activities, loss of spawning, rearing or migration habitat, and predation). However, as described  
21 above, these effects would not be adverse because of the limited extent, intensity, and duration of  
22 expected construction projects in the Plan Area under the NAA and Existing Conditions.

23 In addition, any such construction projects would be subject to a separate environmental  
24 compliance process, with permit stipulations which would include the implementation of project-  
25 specific AMMs, BMPs, environmental commitments and/or mitigation measures. This would include  
26 project-specific erosion and sediment control plans; hazardous materials management plans;  
27 SWPPPs; spill prevention and control plans; and limiting in-water activities to periods of low flow  
28 and/or to times when non-covered fish species are not likely to be present.

29 **NEPA Effects:** The effects of construction projects on the non-covered fish species would not be  
30 adverse, and no additional mitigation would be required.

31 **CEQA Conclusion:** For any projects implemented under the No Action Alternative within the NAA  
32 period, that include in-water construction and maintenance activities, there would be the potential  
33 to stress, injure, or kill non-covered fish species through direct or indirect effects, and the potential  
34 to alter spawning, rearing and/or migration habitat of non-covered fish species through direct loss  
35 or modification. However, such projects would be subject to specific environmental permitting  
36 processes, which would minimize potential effects through the implementation of project-specific  
37 AMMs, BMPs, environmental commitments and/or mitigation measures. Thus, the construction-  
38 related effects under the NAA would be less than significant, and no additional mitigation would be  
39 required.

1 **Impact AQUA-NAA10: Effects of Maintenance of Facilities on Non-Covered Fish Species**

2 **NEPA Effects:** The discussion of potential maintenance activity effects would be similar to the  
3 discussion provided above with the construction effects (Impact AQUA-NAA1) on the covered fish  
4 species, and as concluded, the effect would not be adverse.

5 **CEQA Conclusion:** The conclusion provide above for the construction activity effects (Impact AQUA-  
6 NAA1), would typically be very similar to those expected to occur during maintenance activities.  
7 Thus, the effect would be less than significant.

8 **Water Operations**

9 **Impact AQUA-NAA11: Effects of Water Operations on Entrainment of Non-Covered Fish**  
10 **Species**

11 Available information on the distribution and abundance of the non-covered fish species is provided  
12 in Appendix 11B, *Non-covered Fish and Aquatic Species Descriptions*. Under Existing Conditions, non-  
13 covered fish species are expected to occur in salvage operations at the south Delta facilities  
14 throughout the year. This would include eggs, larvae, juvenile, and adult life stages of the various  
15 fish species entrained at varying times throughout the year. This entrainment would continue into  
16 the future under the No Action Alternative, although improvements in the water export operations  
17 and the salvage processes are expected to reduce the rate of fish entrainment loss over time.

18 **NEPA Effects:** The effect of entrainment of the non-covered fish species would not be adverse.

19 **CEQA Conclusion:** The impact of water operations on entrainment of non-covered fish species  
20 would be the same as described immediately above. The changes in entrainment under the No  
21 Action Alternative would not substantially reduce the non-covered fish populations. Thus, the  
22 impact would be less than significant and no mitigation would be required.

23 **Impact AQUA-NAA12: Effects of Water Operations on Spawning and Egg Incubation Habitat**  
24 **for Non-Covered Fish Species**

25 As described above under AQUA-NAA4 for the covered fish species, water operations in the NAA are  
26 not expected to substantially or consistently affect spawning habitat, compared to Existing  
27 Conditions. Upstream of the Delta, flows could be affected by changes in water storage volumes,  
28 associated with meeting Fall X2 targets included in the USFWS BiOp. Such changes could affect  
29 downstream spawning conditions for some non-covered fish species, when climate change effects  
30 are accounted for (NAA).

31 **NEPA Effects:** The effect would not be adverse over the NAA period, because there would be little  
32 change in suitable spawning conditions under NAA, compared to Existing Conditions.

33 **CEQA Conclusion:** As discussed above, and in Impact AQUA-NAA4, existing water operations would  
34 continue into the future under the No Action Alternative, and the potential effects on spawning  
35 habitat for non-covered fish species would be similar. Therefore, the overall effect would be less  
36 than significant.

1 **Impact AQUA-NAA13: Effects of Water Operations on Rearing Habitat for Non-Covered Fish**  
2 **Species**

3 As described above under AQUA-NAA5 for the covered fish species, water operations under the No  
4 Action Alternative are not expected to substantially or consistently affect rearing habitat, compared  
5 to Existing Conditions. Existing water operations would continue into the future, and the potential  
6 effects on rearing habitat for non-covered fish species would be similar.

7 **NEPA Effects:** The overall effect would not be adverse.

8 **CEQA Conclusion:** As discussed above, in Impact AQUA-NAA5, existing water operations would  
9 continue into the future, under the No Action Alternative, and the potential effects on rearing habitat  
10 for non-covered fish species of primary concern would be similar. Therefore, the overall effect  
11 would be less than significant.

12 **Impact AQUA-NAA14: Effects of Water Operations on Migration Habitat for Non-Covered Fish**  
13 **Species**

14 As described above under AQUA-NAA6 for the covered fish species, water operations under the No  
15 Action Alternative are not expected to substantially or consistently affect overall migration  
16 conditions for the non-covered species. Existing water operations would continue into the future,  
17 and the potential effects on migration habitat of non-covered fish species would be similar.

18 **NEPA Effects:** The overall effects would not be adverse.

19 **CEQA Conclusion:** As described above under AQUA-NAA6 for the covered fish species, water  
20 operations under the No Action Alternative are not expected to substantially or consistently affect  
21 overall migration conditions for the non-covered species. Any existing effects are expected to  
22 continue into the future, under the No Action Alternative. As a result, the potential effects on  
23 migration habitat for non-covered fish species would likely be similar to Existing Conditions.  
24 Therefore, the overall effect would be less than significant.

25 **Restoration Measures (CM2, CM4–CM7, and CM10)**

26 **Impact AQUA-NAA15: Effects of Habitat Restoration on Non-Covered Fish Species**

27 **NEPA Effects:** As described in detail above for the covered fish species, under the No Action  
28 Alternative, no large-scale, long-term comprehensive habitat restoration program is expected to  
29 occur. While restoration activities from various programs and projects in the region would still  
30 occur, the extent of these activities would typically be limited in size or distribution. These activities  
31 would be expected to include enhancing existing habitat, breaching levees and converting  
32 agricultural and other upland areas to tidal, shallow water, open water, and floodplain habitats, as  
33 well as enhancement of channel margin habitat. Therefore, restoration actions would likely occur on  
34 a relatively small scale, and with a typically sporadic and inconsistent implementation schedule.

35 **NEPA Effects:** As the purpose of the restoration measures is intended to benefit aquatic species, the  
36 effects would be unlikely to be adverse.

37 **CEQA Conclusion:** As described above, the No Action Alternative would not include a long-term,  
38 large-scale comprehensive habitat restoration program, to restore habitat functions in the Plan  
39 Area, and benefit the covered and non-covered fish species. Although conservation measures on a  
40 smaller-scale would likely continue to occur into the future, it is unlikely for there to be a

1 comprehensive monitoring program, or adaptive management process to ensure that these actions  
2 were providing a net improvement over Existing Conditions, or providing a substantial benefit to  
3 the species. Despite these uncertainties, the effects would be less than significant.

4 **Other Conservation Measures (CM12–CM19 and CM21)**

5 **Impact AQUA-NAA16: Effects of Other Conservation Measures on Non-Covered Fish Species**

6 As indicated above for the covered fish species, the No Action Alternative would be unlikely to  
7 provide a long-term comprehensive program to address other stressors on the covered and non-  
8 covered fish species. However, some existing and future conservation measures would continue to  
9 occur under the No Action Alternative. These conservation measures are intended to reduce  
10 stressors to covered and non-covered fish species and generally have only neutral or beneficial  
11 effects.

12 **NEPA Effects:** The overall effects would be beneficial.

13 **CEQA Conclusion:** As indicated above, the conservation measures occurring in the future under NAA  
14 are expected to benefit both covered and non-covered fish species. Therefore, the effect would be  
15 expected to be less than significant.

#### 11.3.4.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1A includes the construction of the five north Delta intake facilities (Intakes 1–5) between River Mile (RM) 44 (south of Freeport) and RM 37 (north of the town of Courtland). The locations, dimensions, and construction footprints of the intakes considered in Alternative 1A are provided in Table 11-5. The intakes, the associated bank armoring, and related structures would permanently modify the shoreline and channel of the Sacramento River, reducing habitat suitability for fish species of concern. Six temporary barge landings would be constructed at each of six tunnel shaft locations. These temporary facilities would be removed when construction is completed.

The construction of Alternative 1A would affect environmental conditions in the Sacramento River where the intakes are constructed, and at tunnel shaft locations in the Delta where temporary barge unloading facilities would be operated during pipeline construction (Mapbook M3-1). Construction activities would result in temporary water quality effects (e.g., turbidity); elevated underwater noise conditions (associated with pile driving and the use of equipment such as boats and barges); fish exposure to stranding and direct physical injury; and temporary exclusion or degradation of spawning, rearing, and/or migratory habitats. Short-term effects from project construction would be avoided and minimized by a range of environmental commitments (see Appendix 3B, *Environmental Commitments*).

Once constructed the new facilities will require periodic maintenance to function effectively, resulting in short-term effects on the environment that would occur at a variable frequency depending on planned and unplanned maintenance needs. The effects of maintenance activities are expected to be similar to those described for project construction. However, the scale of those effects will be commensurate with the nature and extent of the maintenance activities conducted during any given year. Project maintenance would include the same range of conservation measures and environmental commitments (see Appendix 3B, *Environmental Commitments*) used during project construction to avoid and minimize adverse effects on fish and aquatic habitats. Operations under Alternative 1A would modify the location and pattern of water withdrawals from the Delta relative to Existing Conditions and the no-action alternative. This would be expected to modify flow conditions in the Delta, producing potential changes in water quality and habitat conditions, and exposure of fish species of concern to impingement, entrainment, and predation. The long-term effects of Alternative 1A operations on habitat conditions would be mitigated through implementation of several large-scale habitat restoration efforts, which are designed to result in a net-beneficial improvement in habitat conditions for aquatic species. Habitat restoration will result in short-term construction-related impacts on habitat conditions.

The following discussion outlines construction and maintenance elements, and the operation of facilities and restoration actions associated with Alternative 1A that could affect fish or their habitat for the covered fish species.

## 1 **Delta Smelt**

### 2 **Construction and Maintenance of CM1**

#### 3 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

4 The potential for delta smelt exposure to Alternative 1A construction effects would be minimized  
5 through construction timing and the fact that the affected areas provide marginal habitat for delta  
6 smelt. Intake facilities 1–5 are located upstream of the primary spawning and rearing habitats,  
7 indicating that the potential for direct effects on delta smelt spawning is likely to be low. However,  
8 the construction footprint overlaps some areas that provide potentially suitable spawning habitats,  
9 and occurs entirely within designated critical habitat. Therefore, the possibility of short-term  
10 adverse effects on delta smelt eggs, larvae and juveniles cannot be entirely discounted and impacts  
11 to habitat must be avoided or minimized to the extent practicable.

#### 12 ***Temporary Increases in Turbidity***

13 Turbidity is a measure of the scattering of light penetration by dissolved and particulate organic and  
14 inorganic matter in the water column, including, but not limited to suspended sediments. However,  
15 the term is commonly used to describe suspended sediment effects associated with construction and  
16 is applied accordingly here. The construction of Alternative 1A would unavoidably result in the  
17 generation and release of suspended sediments to the water column. Increased suspended  
18 sediments will temporarily increase water column turbidity, altering habitat conditions for delta  
19 smelt and other fish species. However, species such as delta and longfin smelt have evolved and  
20 adapted to life in turbid waters to avoid predators and to successfully forage on prey organisms, so  
21 increases in turbidity are expected to generally improve habitat conditions for these species.

22 Turbidity-producing construction activities in the Sacramento River include bed and bank  
23 disturbance during cofferdam placement and removal, channel dredging adjacent to the new intake  
24 locations, and the placement of bed and bank armoring. Propeller wash associated with barge traffic  
25 at the tunnel shaft construction sites would also be expected to produce localized turbidity pulses.  
26 These effects would occur periodically wherever in-water construction activities and/or associated  
27 vessel traffic are taking place.

28 While the construction of Alternative 1A would result in unavoidable turbidity effects, these effects  
29 would be minimized to the extent possible to minimize effects on other species and water quality by  
30 limiting the duration of in-water construction activities and through implementing the  
31 environmental commitments described below and in Appendix 3B, *Environmental Commitments*.  
32 These environmental commitments include *Conduct Environmental Training; Develop and Implement*  
33 *a Stormwater Pollution Prevention Plan (SWPPP); Develop and Implement an Erosion and Sediment*  
34 *Control Plan; Develop and Implement a Hazardous Materials Management Plan (HMMP) that includes*  
35 *a Spill Prevention, Containment, and Countermeasure Plan (SPCCP); Dispose of Spoils, Reusable Tunnel*  
36 *Material, and Dredged Material; Develop and Implement a Fish Rescue and Salvage Plan; and Develop*  
37 *and Implement a Barge Operations Plan*. While delta smelt are not expected to be substantially  
38 exposed to any changes in turbidity during construction, and any exposure would not be adverse  
39 because of their preference for turbid conditions, construction activities would still need to comply  
40 with the standard terms and conditions for in-water work.

41 As such, prior to the onset of construction activities, DWR and/or their contractors will conduct  
42 environmental training to inform field management and construction personnel of the need to avoid

1 and protect sensitive resources during construction of the water conveyance facilities. Turbidity and  
2 sediment control measures that would be implemented by contractors as part of a SWPPP, Erosion  
3 and Sediment Control Plan, and the SPCCP include, but would not be limited to, the following.

4 *SWPPP*

- 5 ● Capture sediment via sedimentation and stormwater detention features.
- 6 ● Implement concrete and truck washout facilities and appropriately sized storage, treatment, and  
7 disposal practices.
- 8 ● Implement appropriate treatment and disposal of construction site dewatering from  
9 excavations to prevent discharges to surface waters.
- 10 ● Prevent transport of sediment at the construction site perimeter, toe of erodible slopes, soil  
11 stockpiles, and into storm drains.
- 12 ● Reduce runoff velocity on exposed slopes.
- 13 ● Inspection and monitoring. A Qualified SWPPP Developer (QSD) would determine the combined  
14 Risk Level (Level 1, 2, or 3) of each construction site, which involves an evaluation of the site's  
15 "Sediment Risk" and "Receiving Water Risk." The SWPPP will also include a site and BMP  
16 inspection schedule. Performance standards will be met by implementing stormwater pollution  
17 prevention BMPs that are tailored to specific site conditions, including the Risk Level of  
18 individual construction sites.
  - 19 ○ Common to all Risk Levels:
    - 20 ● Dischargers will ensure that all inspection, maintenance repair, and sampling activities  
21 at the construction site will be performed or supervised by a QSP representing the  
22 discharger.
    - 23 ● Develop and implement a written site-specific Construction Site Monitoring Program  
24 (CSMP).
  - 25 ○ Inspection, monitoring, and maintenance activities based on the Risk Level of the  
26 construction site (as defined in the SWRCB General Permit).
    - 27 ● Risk Level 1 Sites:
      - 28 ○ Perform weekly inspections of BMPs, and at least once each 24-hour period during  
29 extended storm events.
      - 30 ○ At least two business days (48 hours) prior to each qualifying rain event (a rain  
31 event producing 0.5 inch or more of precipitation), visually inspect: (a) stormwater  
32 drainage areas to identify any spills, leaks, or uncontrolled pollutant sources; (b) all  
33 BMPs to identify whether they have been properly implemented in accordance with  
34 the SWPPP; and (c) stormwater storage and containment areas to detect leaks and  
35 ensure maintenance of adequate freeboard.
      - 36 ○ Visually observe stormwater discharges at all discharge locations within two  
37 business days (48 hours) after each qualifying rain event and identify additional  
38 BMPs and revise the SWPPP accordingly.

- 1           ○ Conduct minimum quarterly visual inspections of each drainage area for the  
2           presence of (or indications of prior) unauthorized and authorized non-stormwater  
3           discharges and their sources.
- 4           ○ Collect one or more samples during any breach, malfunction, leakage, or spill  
5           observed during a visual inspection which could result in the discharge of pollutants  
6           to surface waters that will not be visually detectable in stormwater.
- 7           ● Risk Level 2 Sites:
  - 8           ○ Risk Level 2 dischargers will perform all of the same visual inspection, monitoring,  
9           and maintenance measure specified for Risk Level 1 dischargers.
  - 10          ○ Risk Level 2 dischargers will perform sampling and analysis of stormwater  
11          discharges to characterize discharges associated with construction activity from the  
12          entire disturbed area at all discharge points where stormwater is discharged off site.
  - 13          ○ At a minimum, Risk Level 2 dischargers will collect and analyze three samples per  
14          day for pH and turbidity of a qualifying rain event.
  - 15          ○ Dischargers who deploy an Active Treatment Systems (ATS) on their site, or a  
16          portion on their site, will collect ATS effluent samples and measurements from the  
17          discharge pipe or another location representative of the nature of the discharge.
- 18          ● Risk Level 3 Sites:
  - 19          ○ Risk Level 3 dischargers will perform all of the same visual inspection, monitoring,  
20          and maintenance measure specified for Risk Level 1 and Risk Level 2 dischargers.
  - 21          ○ In the event that a Risk Level 3 discharger violates a numerical effluent limit (NEL)  
22          of the General Permit (i.e., pH and turbidity), and has a direct discharge into  
23          receiving waters, the discharger will subsequently sample receiving waters for all  
24          parameter(s) monitored in the discharge.
  - 25          ○ Risk Level 3 dischargers disturbing 30 acres or more of the landscape and with  
26          direct discharges into receiving waters will conduct or participate in a benthic  
27          macroinvertebrate bioassessment of receiving waters prior to commencement of  
28          construction activity. The SWPPP will also specify the forms and records that must  
29          be uploaded to SWRCB online Stormwater Multiple Application and Report Tracking  
30          System (SMARTS), such as quarterly non-stormwater inspection and annual  
31          compliance reports. If the QSP determines the site is Risk Level 2 or 3, water  
32          sampling for pH and turbidity will be required and the SWPPP will specify sampling  
33          locations and schedule, sample collection and analysis procedures, and  
34          recordkeeping and reporting protocols. In accordance with the CGP numeric action  
35          level requirements, the BDCP contractor will modify existing BMPs or implement  
36          new BMPs when effluent monitoring indicates that daily average runoff pH is  
37          outside the range of 6.5 to 8.5 and that the daily average turbidity is greater than  
38          250 nephelometric turbidity units (NTUs). Additionally, if a given construction  
39          component is Risk Level 3, for that component will report to the SWRCB when  
40          effluent monitoring indicates that daily average runoff pH is outside the range of 6.0  
41          to 9.0 and that the daily average turbidity is greater than 500 NTUs. In the event  
42          that the turbidity NEL is exceeded, it may also be required to sample and report to

1 the SWRCB pH, turbidity, and suspended sediment concentration of receiving  
2 waters for the duration of construction.

- 3 ● The BDCP contractor will also conduct sampling of runoff effluent when a leak, spill, or  
4 other discharge of non-visible pollutants is detected.
- 5 ● The CGP has specific monitoring and action level requirements for the Risk Levels,  
6 which are summarized in Table 3B-3 (Appendix 3B, *Environmental Commitments*).
- 7 ● The QSP will be responsible for day-to-day implementation of the SWPPP, including  
8 BMP inspections, maintenance, water quality sampling, and reporting to SWRCB. If the  
9 water quality sampling results indicate an exceedance of allowable pH and turbidity  
10 levels, the QSD will modify the type and/or location of the BMPs by amending the  
11 SWPPP.

#### 12 *Erosion and Sediment Control Plan*

- 13 ● Install physical erosion control stabilization features (e.g., hydroseeding, mulch, silt fencing) to  
14 capture sediment and control both wind and water erosion.
- 15 ● Design grading to be compatible with adjacent areas and result in minimal disturbance of the  
16 terrain and natural land features.
- 17 ● Divert runoff away from steep, denuded slopes, or other critical areas with barriers, berms,  
18 ditches, or other facilities.
- 19 ● Retain trees and natural vegetation to the extent feasible to stabilize hillsides, retain moisture,  
20 and reduce erosion.
- 21 ● Limit construction, clearing of vegetation, and disturbance of soils to areas of proven stability.
- 22 ● Implement construction management and scheduling measures to avoid exposure to rainfall  
23 events, runoff, or flooding at construction sites to the extent feasible.
- 24 ● Use sediment ponds, silt traps, wattles, straw bale barriers or similar measures to retain  
25 sediment transported by runoff water onsite.
- 26 ● Collect and direct surface runoff at non-erosive velocities to the common drainage courses.

#### 27 *SPCCP*

- 28 ● Absorbent pads, pillows, socks, booms, and other spill containment materials will be maintained  
29 at the hazardous materials storage sites for use in the event of spills.
- 30 ● When transferring oil or other hazardous materials from trucks to storage containers, absorbent  
31 pads, pillows, socks, booms or other spill containment material will be placed under the transfer  
32 area.
- 33 ● Absorbent pads and mats will be placed on the ground beneath equipment before refueling and  
34 maintenance.
- 35 ● Equipment used in direct contact with water will be inspected daily to prevent the release of oil.
- 36 ● Oil-absorbent booms will be used when equipment is used in or immediately adjacent to waters.

- 1 • Fuel transfers will take place a minimum distance from exclusion/drainage areas and streams,  
2 and absorbent pads will be placed under the fuel transfer operation.
- 3 • Equipment will be refueled only in designated areas.
- 4 • Staging areas will be designed to contain contaminants such as oil, grease, and fuel products so  
5 that they do not drain toward receiving waters or storm drain inlets.

6 By implementing measures and BMPs as part of these environmental commitments, the project  
7 would meet the requirements described in the Central Valley Regional Water Quality Control  
8 Board's *Water Quality Control Plan for the Sacramento and San Joaquin River Basins* (Basin Plan) for  
9 turbidity generation which are as follows.

- 10 • Where natural turbidity is between 0 and 5 nephelometric turbidity units (NTUs), increases  
11 shall not exceed 1 NTU.
- 12 • Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20%.
- 13 • Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- 14 • Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10%.

15 Turbidity levels would be monitored throughout construction as part of the SWPPP (see summary  
16 above and Appendix 3B, *Environmental Commitments*). In the event that any of these thresholds  
17 were exceeded, all turbidity-producing activities would be halted until turbidity levels subsided  
18 and/or appropriate corrective measures were taken. Turbidity effects in the Sacramento River  
19 would be limited to the June 1 through October 31 in-water work period for the intake locations, a  
20 period with the least potential for most fish species to be in the vicinity of the in-water construction  
21 activities.

#### 22 *HMMP*

23 The BDCP proponents will ensure that the BDCP contractor will develop and implement a HMMP  
24 before beginning construction. A specific protocol for the proper handling and disposal of hazardous  
25 materials will be established before construction activities begin and will be enforced by the BDCP  
26 proponents. The HMMP will include, but not be limited to, the following measures or practices.

- 27 • Storage and transfer of hazardous materials will not be allowed within 100 feet of streams or  
28 sites known to contain sensitive biological resources except with the permission of CDFW.
- 29 • Soils contaminated by spills or cleaning wastes will be contained and removed to an approved  
30 disposal site.
- 31 • Storage or use of hazardous materials in or near wet or dry streams will be consistent with the  
32 Fish and Game Code and other state laws.

#### 33 *Dispose of Spoils, Reusable Tunnel Material, and Dredged Material*

34 Contractors will properly handle, manage, and dispose of spoils, reusable tunnel material (RTM),  
35 and dredged material. Spoils and RTM will be stored in designated spoils and RTM areas,  
36 respectively. Discharges from RTM dewatering operations will be done in such a way as to not cause  
37 erosion at the discharge point. Spoils materials will not be placed in sensitive habitat areas, such as  
38 wetlands, vernal pools, alkali wetlands or grassland, native grasslands, riparian, or in floodplains  
39 identified by the Federal Emergency Management Agency (FEMA). Debris, rubbish, and other  
40 materials not directed to be salvaged will be removed from the work site as the contractor's

1 property. Removed material will be disposed of in an approved disposal site and the contractor will  
2 obtain permits required for such disposal.

3 Following completion of construction, restoration of the RTM dewatering sites will be designed to  
4 prevent surface erosion and subsequent siltation of adjacent water bodies.

5 Dredged material will be disposed of in upland disposal sites to help ensure that the material will  
6 not be in contact with surface water. Handling and management of dredged material will include,  
7 but not be limited to, the following measures in addition to complying with applicable local, state  
8 and federal regulations.

- 9 ● Conduct dredging activities in a manner that will not cause turbidity increases in the receiving  
10 water, as measured in surface waters 300 feet down-current from the construction site, to  
11 exceed the Basin Plan objectives beyond an approved averaging period by the Regional Water  
12 Quality Control Board (RWQCB) and CDFW.
- 13 ● Silt curtains will be utilized to control turbidity if turbid conditions generated during dredging  
14 exceed the agreed-upon implementation requirements for compliance with the Basin Plan  
15 objectives.
- 16 ● Design, construct, operate, and maintain the dredge material disposal site to prevent inundation  
17 or washout due to floods with a 100-year return frequency.
- 18 ● Maintain 2 feet of freeboard in all dredge material disposal site settling pond(s) at all times  
19 when they may be subject to washout from a flooding event.
- 20 ● Constructed DMD sites using appropriate BMPs to prevent discharges of contaminated  
21 stormwater to surface waters or groundwater.

22 Under Alternative 1A, six barge landings would be constructed and approximately 3,000 barge trips  
23 are projected to carry construction materials to the barge unloading facilities. The barge trips would  
24 take place continuously throughout construction, indicating that periodic turbidity pulses from  
25 propeller wash and wakes at the barge landings could occur year-round at the tunnel shaft locations.  
26 This potential impact would be minimized by implementing measures as part of a Barge Operations  
27 Plan (Appendix 3B, *Environmental Commitments*).

#### 28 *Barge Operations Plan*

29 BDCP construction contractors would implement the following avoidance measures to ensure that  
30 the goal of avoiding impacts on aquatic resources from tugboat and barge operations will be  
31 achieved.

- 32 ● Training of tugboat operators.
- 33 ● Prior to bringing equipment into the Delta, inspect and clean all in-water equipment such as  
34 barges and small work boats to prevent introduction of invasive aquatic species (plants, fish and  
35 animals)
- 36 ● Dock approach and departure protocol
  - 37 ○ All vessels will approach and depart from the intake and barge landing sites at dead slow in  
38 order to reduce vessel wake and propeller wash at the sites frequented by tug and barge  
39 traffic.

- 1           ○ In order to minimize bottom disturbance, anchors and barge spuds will be used to secure  
2           vessels only when it is not possible to tie up.
- 3           ○ Barge anchoring will be pre-planned. Anchors will be lowered into place and not be allowed  
4           to drag across the channel bed.
- 5           ○ Vessel operators will limit vessel speed as necessary to maintain wake of less than 2 feet (66  
6           cm) at shore.
- 7           ○ Vessel operators will avoid pushing stationary vessels up against the cofferdam, dock or  
8           other structures for extended periods since this could result in excessive directed propeller  
9           wash impinging on a single location. Barges will be tied up whenever possible to avoid the  
10          necessity of maintaining stationary position by tugboat or by the use of barge spuds.
- 11          ○ Limiting vessel speed to minimize the effects of wake impinging on unarmored or vegetated  
12          banks and the potential for vessel wake to strand small fish; limiting the direction and/or  
13          velocity of propeller wash to prevent bottom scour and loss of aquatic vegetation; and  
14          prevention of spillage of materials and fluids from vessels, among other potential effects.
- 15          ○ When transporting loose materials (e.g., sand, aggregate), barges will use deck walls or  
16          other features to prevent loose materials from blowing or washing off of the deck.

17          The plan would specify operating criteria during barge landing and departure designed to minimize  
18          erosion and turbidity generation associated with vessel wakes and propeller wash.

19          As noted above, delta smelt evolved in environments with relatively high natural turbidity levels,  
20          and seek out areas with low water clarity for cover from predatory birds and fish. They are well-  
21          adapted to turbidity, to the extent that larval and juvenile smelt are unable to forage effectively in  
22          clear water conditions (Baskerville-Bridges et al. 2004; Moyle 2002). Baseline turbidity conditions  
23          in the Delta range from 10 to 40 NTUs, increasing to 250 and 500 NTUs under high discharge  
24          conditions. Turbidity levels in tidal habitats are commonly higher than those in more freshwater  
25          areas, due to sediment resuspension off of mudflats by wind-driven waves. For example, baseline  
26          turbidity levels in Suisun Bay commonly range from 50 to 100 NTUs.

27          With environmental commitments, turbidity levels would be expected to be maintained within the  
28          natural range of variability likely to occur under baseline conditions. The environmental  
29          commitments summarized in this impact and contained in Appendix 3B, *Environmental*  
30          *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
31          *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
32          *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
33          *and Salvage Plan; and Barge Operations Plan)* would be expected to effectively limit any increases in  
34          turbidity, such that any effects on delta smelt would be minimal, and not adverse.

### 35          **Accidental Spills**

36          Construction of Alternative 1A could result in accidental spills of contaminants, including cement,  
37          oil, fuel, hydraulic fluids, paint, and other construction-related materials, resulting in localized water  
38          quality degradation. This could in turn result in adverse effects on delta smelt, through direct injury  
39          and mortality (e.g., damage to gill tissue causing asphyxiation) or delayed effects on growth and  
40          survival (e.g., increased stress or reduced feeding), depending on nature and extent of the spill and  
41          the contaminants involved.

1 The greatest potential for an adverse water quality impact is associated with an accidental spill from  
2 construction activities occurring in or near surface waters. The north Delta intakes and construction  
3 and operation of the temporary barge landings at the tunnel shafts both involve extensive in-water  
4 work. Other construction elements that occur in upland areas or are isolated from fish-bearing  
5 waters, and have little potential for accidental spills that could affect fish. Implementation of  
6 environmental commitments (*Environmental Training; Stormwater Pollution Prevention Plan;*  
7 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
8 *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
9 *Material; and Barge Operations Plan*), described in the summary below and specifically the *Spill*  
10 *Prevention, Containment, and Countermeasure Plan* (see of Appendix 3B, *Environmental*  
11 *Commitments*) would be expected to minimize the potential for introduction of contaminants to  
12 surface waters and provide for effective containment and cleanup should accidental spills occur. On  
13 this basis, the likelihood of adverse effects on delta smelt resulting from accidental spills is  
14 considered negligible.

#### 15 SPCCP

16 The BDCP proponents will ensure that the BDCP contractor will develop and implement SPCCPs.  
17 Multiple SPCCPs will be developed to take into account site-specific conditions, and implemented to  
18 minimize effects from spills of oil or oil-containing products during BDCP construction and  
19 operation. The SPCC Plans will include, but not be limited to, the following measures and practices.

- 20 ● Personnel will be trained in emergency response and spill containment techniques, and will also  
21 be made aware of the pollution control laws, rules, and regulations applicable to their work.
- 22 ● Petroleum products will be stored in non-leaking containers at impervious storage sites from  
23 which runoff is not permitted to escape.
- 24 ● Absorbent pads, pillows, socks, booms, and other spill containment materials will be maintained  
25 at the hazardous materials storage sites for use in the event of spills.
- 26 ● Contaminated absorbent pads, pillows, socks, booms, and other spill containment materials will  
27 be placed in non-leaking sealed containers until transport to an appropriate disposal facility.
- 28 ● When transferring oil or other hazardous materials from trucks to storage containers, absorbent  
29 pads, pillows, socks, booms or other spill containment material will be placed under the transfer  
30 area.
- 31 ● Absorbent pads and mats will be placed on the ground beneath equipment before refueling and  
32 maintenance.
- 33 ● Equipment used in direct contact with water will be inspected daily to prevent the release of oil.
- 34 ● Oil-absorbent booms will be used when equipment is used in or immediately adjacent to waters.
- 35 ● All reserve fuel supplies will be stored only within the confines of a designated staging area.
- 36 ● Fuel transfers will take place a minimum distance from exclusion/drainage areas and streams,  
37 and absorbent pads will be placed under the fuel transfer operation.
- 38 ● Equipment will be refueled only in designated areas.
- 39 ● Staging areas will be designed to contain contaminants such as oil, grease, and fuel products so  
40 that they do not drain toward receiving waters or storm drain inlets.

- 1 • All stationary equipment will be positioned over drip pans.
- 2 • In the event of a spill, personnel will identify and secure the source of the discharge and contain
- 3 the discharge with sorbents, sandbags, or other material from spill kits and will contact
- 4 appropriate regulatory authorities (e.g., National Response Center will be contacted if the spill
- 5 threatens navigable waters of the United States or adjoining shorelines, as well as other
- 6 response personnel).

7 Methods of cleanup may include the following.

- 8 • Physical—Physical methods for the cleanup of dry chemicals include the use of brooms, shovels,
- 9 sweepers, or plows.
- 10 • Mechanical—Mechanical methods could include the use of vacuum cleaning systems and pumps.
- 11 • Chemical—Cleanups of material can be achieved with the use of appropriate chemical agents
- 12 such as sorbents, gels, and foams.

### 13 ***Disturbance of Contaminated Sediments***

14 The construction footprint for Alternative 1A includes areas with known or potentially  
15 contaminated sediments, indicating the potential for release and dispersal of these contaminants if  
16 these sediments are disturbed during construction. Individual delta smelt could be directly exposed  
17 to elevated levels of contaminants if they are in immediate proximity to construction activities that  
18 disturb contaminated sediments. Bed disturbance could also result in indirect effects on delta smelt.  
19 Toxins in river channel sediments can enter the food chain via benthic organisms. If contaminated  
20 sediments are disturbed and become suspended in the water column, they also become available  
21 directly to pelagic organisms, including covered fish species and planktonic food sources of covered  
22 species. Thus, construction-related disturbance of contaminated bottom sediments opens up  
23 another potential pathway to the food chain, and the potential bioaccumulation of these toxins in  
24 various fish species. The bioaccumulation of toxins can lead to lethal effects, as well as a number of  
25 sublethal effects (e.g., effects on behavior, tissues and organs, reproduction, growth, and immune  
26 system) (Connon et al. 2011).

27 The potential effects of toxins on covered fish species would depend on the types and  
28 concentrations of the toxins in disturbed sediments. Unfortunately, little chemical data are available  
29 related to sediments in the construction areas. Toxins that tend to bind to particulates do not mix  
30 homogeneously into the sediment, and concentrations can vary widely over a small area. A  
31 discussion of the available sediment chemical data and the factors that determine the potential for  
32 impacts from toxins in sediments is presented below.

33 The five water intakes would be located in the Sacramento River, downstream of the main urban  
34 area of the City of Sacramento. Sediments at these locations could be affected by historical and  
35 current urban discharges from the City of Sacramento. Metals (lead and copper), hydrocarbons,  
36 organochlorine pesticides, and PCBs are common urban contaminants with the greatest affinity for  
37 sediments; these contaminants could be present in sediments that would be disturbed during  
38 installation of the cofferdams and dredging. In addition, mercury is present in the Sacramento River  
39 system and could be sequestered in bottom sediments. The barge landings would be constructed on  
40 smaller waterways, which are more likely to contain agricultural-related toxins such as copper and  
41 organochlorine pesticides.

1 Metals, PCBs, and hydrocarbons (typically oil and grease) are common urban contaminants that are  
2 introduced to aquatic systems via nonpoint-source stormwater drainage, industrial discharges, and  
3 municipal wastewater discharges. Many of these contaminants readily adhere to sediment particles  
4 and tend to settle out of solution relatively close to the primary source of contaminants. PCBs are  
5 persistent, adsorb to soil and organics, and bioaccumulate in the food chain. Lead and other metals  
6 also will adhere to particulates and organics, and many metals will also bioaccumulate to levels  
7 sufficient to cause adverse biological effects. Hydrocarbons biodegrade over time in an aqueous  
8 environment and do not tend to bioaccumulate; thus, they are not persistent.

9 Because the toxins are entering the water column attached to sediment, their movement is closely  
10 linked to turbidity, which is an indicator of the amount of particulates in the water column.  
11 Turbidity, and in turn suspension of sediments, would be minimized by implementation of  
12 environmental commitments described in the summary below and in Appendix 3B, *Environmental*  
13 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
14 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
15 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
16 *and Salvage Plan; and Barge Operations Plan)*. In addition, exposure of covered fish species to any  
17 disturbed contaminated sediments would be minimized because in-water construction activities  
18 would occur between June 1 and October 31 when most covered fish species are least abundant in  
19 the in-water construction area (see Section 11.3.1.1, *Potential Impacts Resulting from Construction*  
20 *and Maintenance of Water Conveyance Facilities*).

21 Prior to the onset of construction activities, BDCP proponents and/or their contractors will conduct  
22 environmental training to inform field management and construction personnel of the need to avoid  
23 and protect sensitive resources during construction of the water conveyance facilities. Turbidity and  
24 sediment control measures would be implemented by contractors as part of a SWPPP and an  
25 Erosion and Sediment Control Plan, as described above under *Temporary Increases in Turbidity*.

26 To avoid effects from disturbing contaminated sediments, the BDCP proponents will ensure that the  
27 BDCP contractor will develop and implement an HMMP before beginning construction. Multiple  
28 HMMPs would be developed to take into account specific site conditions. In addition to the measures  
29 described under *Temporary Increases in Turbidity*, HMMP measures to address contaminated  
30 sediments will include, but not be limited to, the following.

- 31 ● Soils contaminated by spills or cleaning wastes will be contained and removed to an approved  
32 disposal site.
- 33 ● Storage or use of hazardous materials in or near wet or dry streams will be consistent with the  
34 Fish and Game Code and other state laws.
- 35 ● Hazardous waste generated at work sites, such as contaminated soil, will be segregated from  
36 other construction spoils and properly handled, hauled, and disposed of at an approved disposal  
37 facility by a licensed hazardous waste hauler in accordance with state and local regulations. The  
38 contractor will obtain permits required for such disposal.

39 Proper handling, storage, and disposal of contaminated sediments would avoid and minimize the  
40 entry of contaminants into water bodies. In addition to measures described in *Disposal of Spoils,*  
41 *Reusable Tunnel Material, and Dredged Material* under *Temporary Increases in Turbidity*, above,  
42 measures relevant to this impact include the following (see Appendix 3B for the complete plan).

- 1 ● RTM and RTM decant liquid will undergo chemical characterization by the contractor(s) prior to  
2 reuse or discharge, respectively, to meet NPDES and the Central Valley Water Board  
3 requirements.
  - 4 ● Should RTM or RTM decant liquid constituents exceed discharge limits, these tunneling  
5 byproducts will be treated to comply with NPDES permit requirements. Discharges from RTM  
6 dewatering operations will be done in such a way as to not cause erosion at the discharge point.
  - 7 ● If RTM liquid requires chemical treatment, chemical treatment will be nontoxic to aquatic  
8 organisms.
  - 9 ● Hazardous materials excavated during construction will be segregated from other construction  
10 spoils and properly handled in accordance with applicable state and local regulations. Riverine  
11 or in-Delta sediment dredging and dredge material disposal activities involve potential  
12 contaminant discharges not addressed through typical NPDES or SWRCB General Permit  
13 processes. Construction of Dredge Material Disposal (DMD) sites will likely be subject to the  
14 SWRCB General Permit (Order No. 2009-0009-DWQ).
  - 15 ● The BDCP proponents will implement BMPs such as, but not limited to:
    - 16 ○ Prior to initiating any dredging activity, contractors will prepare and implement a pre-  
17 dredge sampling and analysis plan (SAP) (as part of the water plan required per standard  
18 DWR contract specifications Section 01570) to evaluate the presence of contaminants that  
19 may impact water quality from a variety of discharge routes.
    - 20 ○ The DMD will be designed to contain all of the dredged material to the extent practicable,  
21 and all systems and equipment associated with necessary return flows from the DMD site to  
22 the receiving water will be operated to maximize treatment of return water and optimize  
23 the quality of the discharge.
    - 24 ○ DMD sites will be constructed using appropriate BMPs to prevent discharges of  
25 contaminated stormwater to surface waters or groundwater.
- 26 To address contamination risk from barge operations, BDCP construction contractors will  
27 develop, submit, and implement a barge operations plan per standard DWR contract  
28 specifications as part of the traffic plans required in Section 01570. This plan is intended to  
29 protect aquatic species and habitat in the vicinity of barge operations. If and when  
30 avoidance is not possible, the plan will include provisions to minimize, reduce, or mitigate  
31 effects on aquatic species.
- 32 The barge operations plan will be part of a comprehensive traffic control plan coordinated  
33 with the Coast Guard for large channels, which will address traffic routes and machines used  
34 to deliver materials to and from the barges. The plan will address contamination risks such  
35 as the following:
- 36 ○ Accidental material spillage.
  - 37 ○ Sediment and benthic (bottom-dwelling) community disturbance from accidental or  
38 intentional barge grounding or deployment of barge spuds (extendable shafts for  
39 temporarily maintaining barge position).
  - 40 ○ Hazardous materials spills (e.g., fuel, oil, hydraulic fluids).

41 The plan will serve as a guide to barge operations and to a Biological Monitor who will evaluate  
42 barge operations with respect to stated performance measures. Construction contractors operating

1 barges as part of BDCP facilities construction will be responsible for operating their vessels safely;  
2 developing and implementing the barge operations plan; reporting any spills, incidents or  
3 deviations from the plan that might pose risks to species or water quality to the Project Biological  
4 Monitor and/or DWR; and following all other relevant plans.

#### 5 ***Underwater Noise***

6 Alternative 1A construction involves the use of vibratory and impact pile driving to place temporary  
7 sheet piles (for cofferdams used to isolate the intake construction sites), and temporary steel piles  
8 for barge mooring and loading areas at the tunnel shaft construction sites. Impact pile driving  
9 produces underwater sound levels that have the potential to harm fish, while vibratory pile driving  
10 does not. DWR proposes to use vibratory methods wherever practicable to avoid adverse effects on  
11 delta smelt and other species. However, it is likely that impact pile driving would be required in  
12 some locations, indicating the potential for adverse effects on delta smelt that occur nearby.

13 As discussed earlier (*Section 11.3.1.1 Underwater Noise*), the degree of effect is a function of the  
14 intensity of the sound (measured in decibels [dB]), the distance from the source, the duration of  
15 exposure, the size of the fish exposed and the species-specific sensitivity. The potential for injury is a  
16 function of cumulative sound exposure level ( $SEL_{cumulative}$ ) during a 12-hour period.

17 Fish smaller than 2 grams are more sensitive to cumulative sound exposure levels than larger  
18 individuals, and are thought to experience injury when underwater noise exposure reaches 183-dB  
19  $SEL_{cumulative}$ . Larval and juvenile delta smelt are uniformly smaller than 2 grams. Adult delta smelt  
20 are close to 2 grams (mature male and female delta smelt average 2.1 grams and 2.7 grams with a  
21 standard error of 0.3 and 0.6 grams, respectively [Foott and Bigelow 2010]). Because some portion  
22 of the adult delta smelt population weighs less than the 2-gram limit, the lower injury threshold  
23 should apply to this life stage as well.

24 The potential for delta smelt exposure to underwater noise impacts is determined by the overlap of  
25 construction activities (timing, location, duration) and delta smelt distribution by life history stage.  
26 The estimated duration of potential exposure to pile driving is 6 days each in June and July (Table  
27 11-9). Delta smelt are generally found in the west Delta and Cache Slough/Liberty Island area during  
28 the spring and summer, meaning that the majority of individuals would not be exposed to  
29 construction-related underwater noise. However, individual delta smelt could be present at low  
30 abundance in the north, east, and south Delta during this period when in-water construction activity  
31 would occur, indicating some potential for exposure. Adult delta smelt complete their spawning  
32 cycle and die by mid- to late June. Adult delta smelt transiting areas where pile driving occurs could  
33 experience direct adverse effects. If smelt spawn upstream of construction areas, larvae could  
34 potentially drift through the areas affected by underwater sound. There is a slight potential for  
35 spawning adults (during June) or larval delta smelt (during June and July) to occur in the vicinity of  
36 the intakes and the barge landings during the in-water construction period (see Table 11-4). If an  
37 individual larval delta smelt was present in the area affected by underwater sound from impact pile  
38 driving above the 183-dB  $SEL_{cumulative}$  level, it could experience direct injury or mortality.

39 Alternative 1A includes timing restrictions and limitations on the duration of impact pile driving  
40 activities. Implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize, but not  
41 completely avoid, adverse effects on delta smelt from exposure to underwater noise.

42 Other construction activities would be unlikely to result in underwater noise level sufficient to  
43 adversely affect delta smelt. Activities could involve divers and use of surface equipment such as

1 boats and barges that may temporarily elevate underwater noise levels above ambient conditions.  
2 However, the resulting noise levels are not expected to reach a level that would harm juvenile or  
3 adult fishes. Routine maintenance activities of this kind typically produce noise levels below the  
4 behavioral effects threshold of 150 dB root-mean-squared (RMS). NMFS (2001) has determined that  
5 underwater sound pressure levels less than 150 dB RMS may temporarily alter fish behavior but do  
6 not result in permanent harm or injury.

### 7 ***Fish Stranding***

8 In-water work activities have the potential to cause take of fish through the process of capturing and  
9 rescuing stranded or trapped fish from construction areas. In-water work activities at the north  
10 Delta intakes would include installation of sheet pile cofferdams at each intake location to isolate  
11 active construction activities from the Sacramento River and minimize the potential for increases in  
12 turbidity.

13 Although delta smelt larval and adult life stages are potentially present in the vicinity of the intakes  
14 from January through July, the timing of cofferdam installation (June through August) would avoid  
15 the majority of the spawning and larval recruitment season when delta smelt are most likely to be  
16 present (see Table 11-4). Potential effects of fish stranding typically result in direct or indirect injury  
17 or mortality from subsequent dewatering of work areas and other construction activities. These  
18 effects would be minimized by implementation of environmental commitments described in the  
19 summary below and in Appendix 3B, *Environmental Commitments (Fish Rescue and Salvage*  
20 *Plan)*. Although fish would likely avoid the noise and activity of sheet pile installation, cofferdams  
21 have the potential to entrap some fish. While the number of fish affected is unknown, entrapment  
22 could include a few hundred fish (total of all species), potentially including a small number of delta  
23 smelt.

### 24 ***Fish Rescue and Salvage Plan***

25 DWR will develop the Fish Rescue and Salvage Plan and submit it to the appropriate resource  
26 agencies (CDFW, USFWS, and NMFS) for their review and acceptance, and revise it accordingly. The  
27 plan will include detailed procedures for fish rescue and salvage to minimize the number of fish  
28 stranded during placement and removal of cofferdams at the intake construction sites. The plan will  
29 identify the appropriate procedures for removing fish from the construction zone, and preventing  
30 fish from re-entering the construction zone during construction, or prior to dewatering. The plan  
31 will include detailed fish collection, holding, handling, and release procedures.

32 Prior to construction site dewatering, fish will be captured and relocated to avoid direct mortality  
33 and to minimize take. The appropriate fish collection method will be determined by a qualified fish  
34 biologist, in consultation with the designated resource agency biologist, and based on site-specific  
35 conditions prior to dewatering the cofferdam. Collection methods may include use of seines (nets)  
36 and/or dip nets to collect and remove fish, and electrofishing techniques may also be permitted.  
37 Although the use of these methods can also result in fish injury or mortality, these effects are  
38 typically minor, and often avoided by appropriate training. In addition, these methods have varying  
39 degrees of effectiveness, resulting in some trapped or stranded fish not being rescued.

40 The results of the fish rescue and salvage operations (including date, time, location, comments,  
41 method of capture, fish species, number of fish, approximate age, condition, release location, and  
42 release time) will be reported to the appropriate resource agencies, as specified in the pertinent  
43 permits.

1 ***In-Water Work Activities***

2 In-water work activities have the potential to injure or kill fish through direct physical injury from  
3 construction activities. In-water work activities at the north Delta intakes would include installation  
4 of sheet pile cofferdams at each intake location, piles at each barge landing, placement of riprap to  
5 protect the stream banks adjacent to the intakes from erosion, and dredging.

6 Although fish would likely avoid the noise and activity of pile installation and placement of riprap  
7 protection, these activities have the potential to result in direct and indirect injury or mortality;  
8 trapped or stranded fish would be susceptible to increased sound exposure effects from pile driving,  
9 riprap placement can crush or displace fish, and dredging activities can also crush or entrain fish.  
10 Delta smelt larval and adult life stages may potentially be present in the vicinity of the intakes and  
11 barge landings during January through July; however, the timing of cofferdam and riprap installation  
12 (June through October) would avoid most of the spawning season (January through June, with peak  
13 numbers in the north Delta during February through May) when delta smelt are most likely to be  
14 present (see Table 11-4). In addition to these timing restrictions, potential in-water activity effects  
15 would be minimized by implementation of the environmental commitments described in Appendix  
16 3B, *Environmental Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of Spoils*,  
17 *Reusable Tunnel Material*, and *Dredged Material*; and *Barge Operations Plan*. Pertinent aspects of  
18 these plans include, respectively the following.

- 19 ● Install physical erosion control stabilization features (hydroseeding, mulch, silt fencing, fiber  
20 rolls, sand bags, and erosion control blankets) to capture sediment and control both wind and  
21 water erosion.
- 22 ● Divert runoff away from steep, denuded slopes, or other critical areas with barriers, berms,  
23 ditches, or other facilities.
- 24 ● Discharges from RTM dewatering operations will be done in such a way as to not cause erosion  
25 at the discharge point. If RTM liquid requires chemical treatment, chemical treatment will be  
26 nontoxic to aquatic organisms.
- 27 ● Following completion of construction, restoration of the RTM dewatering sites will be designed  
28 to prevent surface erosion and subsequent siltation of adjacent water bodies.
- 29 ● Conduct dredging within the allowable seasonal “work windows” established by the regulatory  
30 agencies.
- 31 ● Conduct dredging activities in a manner that will not cause turbidity increases in the receiving  
32 water, as measured in surface waters 300 feet down-current from the construction site, to  
33 exceed the Basin Plan objectives beyond an approved averaging period by the RWQCB and  
34 CDFW.
- 35 ● The DMD will be designed to contain all of the dredged material to the extent practicable, and all  
36 systems and equipment associated with necessary return flows from the DMD site to the  
37 receiving water will be operated to maximize treatment of return water and optimize the quality  
38 of the discharge.
- 39 ● The Barge Operations Plan will include training of tugboat operators, limiting vessel speed to  
40 minimize the effects of wake impinging on unarmored or vegetated banks and the potential for  
41 vessel wake to strand small fish, limiting the direction and/or velocity of propeller wash to  
42 prevent bottom scour and loss of aquatic vegetation, and preventing spills of materials and  
43 fluids from vessels.

- 1 • In order to minimize bottom disturbance, anchors and barge spuds will be used to secure  
2 vessels only when it is not possible to tie up.
- 3 • Barges will not be anchored where they will ground during low tides.
- 4 • When transporting loose materials (e.g., sand, aggregate), barges will use deck walls or other  
5 features to prevent loose materials from blowing or washing off of the deck.

#### 6 ***Loss of Spawning, Rearing, or Migration Habitat***

7 In-water construction would temporarily or permanently alter habitat conditions in the vicinity of  
8 the construction activities, but the use of the affected habitats for delta smelt spawning and rearing  
9 is likely limited, based on available data (Merz et al. 2011). Therefore, the resulting habitat effects  
10 are not likely to be limiting to population productivity because it represents a very small portion of  
11 the available habitat in the Delta (Werner et al. 2010). Construction and channel dredging would  
12 result in a permanent loss of up to approximately 8,300 lineal feet of Sacramento River channel  
13 margin within potential delta smelt migration, spawning, and rearing habitat (see Table 11-5).  
14 Cofferdams would isolate the work areas, temporarily reducing the width of riverine habitat  
15 available to fish for migration and rearing, but this will have an insignificant effect on upstream and  
16 downstream fish passage because the cofferdams would typically occupy only about 10% of the  
17 cross section of the river, and cumulatively occupy only a couple of miles of the overall river length.  
18 These isolated areas also represent a very small portion of the available migration and rearing  
19 habitat in the Delta, and there is no indication that these areas are uniquely important to the overall  
20 viability of the delta smelt population. Alternative 1A will result in the permanent loss of low-quality  
21 migration, spawning, and rearing habitat where the existing river banks and bed areas would be  
22 replaced with permanent in-water structures. However, the affected areas have steeply sloped and  
23 armored stream banks lacking riparian vegetation, which are thought to be low suitability habitats  
24 for delta smelt spawning (U.S. Fish and Wildlife Service 2008).

25 Each of the five proposed barge landings would include in-water and over-water structures, such as  
26 piling dolphins, docks, ramps, and possibly conveyors for loading and unloading materials; and  
27 vehicles and other machinery. The barge landings would each occupy approximately 15,000 square  
28 feet of nearshore habitat within their respective delta channels (see Mapbook M3-1 for locations). In  
29 addition to effects of the constructed barge landings on habitat, barge operations have the potential  
30 to affect bottom sediments and benthic habitat through propeller wash effects. This is most relevant  
31 in the vicinity of the barge landings and in narrow channels where tugboats will be near the channel  
32 bottom and could stir up bottom sediments and submerged aquatic vegetation, potentially resulting  
33 in temporary disturbance of rearing habitat. Tugboat and barge speeds in the narrow channels  
34 would be low enough that vessel wakes are not expected to affect shoreline habitat.

35 Potential effects of these in-water structures and activities would be minimized by limiting the size  
36 of the in-water structures where practicable, limiting the amount of dredging and other habitat  
37 disturbing activities, adhering to the approved in-water construction window (expected to be June 1  
38 through October 31), and implementing environmental commitments described in Appendix 3B,  
39 *Environmental Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of Spoils, Reusable*  
40 *Tunnel Material, and Dredged Material*; and *Barge Operations Plan*. Specific measures of those plans  
41 previously described for turbidity, accidental spills, and in-water work activities also would address  
42 the loss of habitat. Additional potentially relevant elements of the Erosion and Sediment Control  
43 Plan include the following.

- 1 • Conduct frequent site inspections (before and after significant storm events) to ensure that  
2 control measures are working properly and to correct problems as needed.
- 3 • Deposit or store excavated materials away from drainage courses.
- 4 • Vegetative material from work site clearing will be chipped, stockpiled, and spread over the  
5 topsoil after earthwork is completed when practical and appropriate to do so.
- 6 • Rocks and other inorganic grubbed materials will be placed in the common backfill whenever  
7 possible. Debris, rubbish, and other materials not directed to be salvaged will be removed from  
8 the work site.

### 9 **Predation**

10 In-water pilings and over-water structures, such as those that would be constructed at the barge  
11 landings have the potential to attract predatory fish that may prey on delta smelt. Docks and  
12 associated pilings provide shade and cover that attract certain predatory fish species, including  
13 striped bass, largemouth bass, smallmouth bass, spotted bass, crappie, and Sacramento  
14 pikeminnow. In addition to fish, water birds (e.g., gulls, terns, cormorants, grebes, mergansers,  
15 egrets, and herons) prey on fish in the Delta. Pilings and other structures may provide perching  
16 habitat for avian predators and cover for introduced predacious fish species. While fish predators  
17 could use this cover to ambush prey, and potentially improve their foraging success, avian predators  
18 are unlikely to forage directly from the docks or piles. Therefore, the overwater piers and support  
19 structures would represent a very small increase in the overall predator habitat the Delta.  
20 Therefore, it is not likely that temporary structures associated with construction would increase  
21 habitat availability sufficiently to increase the abundance of avian and fish predators relative to  
22 baseline conditions.

23 This indicates that the likelihood of increased predation on delta smelt associated with project  
24 construction is minimal. However, it is plausible that localized increases in predation rates could  
25 occur if in-water and over-water structures provide suitable predator habitat in proximity to  
26 concentrations of delta smelt although these localized increases are not expected to have wide-  
27 spread or population level effects.

### 28 **Summary**

29 Construction of Alternative 1A includes several elements with the potential to cause adverse effects  
30 on delta smelt through spills of hazardous materials or underwater noise. However, adverse effects  
31 will be effectively avoided and minimized by siting construction in areas that are minimally used by  
32 this species, and through the use of in-water work windows, activity-specific timing restrictions, and  
33 environmental commitments.

34 Alternative 1A includes several environmental commitments that will avoid and limit spills,  
35 potentially leading to adverse water quality effects on delta smelt. These include *Environmental*  
36 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
37 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of*  
38 *Spoils, Reusable Tunnel Material, and Dredged Material* (see Appendix 3B, *Environmental*  
39 *Commitments*). These commitments would guide rapid and effective response in the case of  
40 inadvertent spills of hazardous materials. In combination with the species' natural tolerance to  
41 elevated turbidity levels, and limited occurrence in the construction areas, these environmental

1 commitments would be expected to protect delta smelt from any adverse water quality effect  
2 resulting from project construction.

3 Delta smelt could be adversely affected by elevated underwater noise associated with impact pile  
4 driving and direct exposure to construction-related disturbance. The number of individuals affected  
5 is expected to be limited, based on the fact that delta smelt are typically present at low densities in  
6 the affected habitats during the in-water work window. This will minimize, but perhaps not  
7 completely avoid, the potential for injury or mortality. Mitigation Measures AQUA-1a and AQUA-1b,  
8 would also minimize adverse effects from impact pile driving. Implementation of environmental  
9 commitments *Fish Rescue and Salvage Plan* and *Barge Operations Plan* (as described in Appendix 3B,  
10 *Environmental Commitments*) would also minimize adverse effects from construction-related  
11 disturbance. Construction of the approach canal and Byron Tract Forebay would not affect fish-  
12 accessible waterways and therefore would not affect delta smelt. As a result, while these  
13 construction activities could adversely affect individual delta smelt, these effects would not result in  
14 adverse population level effects on delta smelt.

15 Construction would not be expected to measurably increase predation rates relative to baseline  
16 conditions because the locally increased predator habitat and predation from temporary  
17 construction structures would not have population level effects.

18 Construction of Alternative 1A will result in both temporary and permanent alteration of migration,  
19 spawning, and rearing habitats used by delta smelt. However, these effects are not expected to be  
20 adverse from a population standpoint, because local water quality conditions (very low electrical  
21 conductivity and typically low turbidity limit the suitability of this river reach for delta smelt  
22 (Werner et al. 2010). Moreover, any habitat losses will be offset by habitat restoration and the  
23 beneficial operational effects of Alternative 1A (described below) on the Delta as a whole.

24 **NEPA Effects:** As a result, these construction activities would not likely result in adverse effects on  
25 delta smelt.

26 **CEQA Conclusion:** The potential impact on delta smelt from construction activities is considered less  
27 than significant due to implementation of the measures described in Appendix 3B, *Environmental*  
28 *Commitments*, such as *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and*  
29 *Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and*  
30 *Countermeasure Plan*; *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue*  
31 *and Salvage Plan*; and *Barge Operations Plan*. These measures would guide rapid and effective  
32 response in the case of inadvertent spills of hazardous materials. This species' natural tolerance to  
33 of turbidity, would likely avoid the risk of any adverse turbidity effects resulting from project  
34 construction. Construction would not be expected to increase predation rates relative to baseline  
35 conditions. Construction associated with Alternative 1A will result in both temporary and  
36 permanent alteration of rearing and migratory habitats used by delta smelt. However, these effects  
37 are not expected to be significant because the loss of habitat is not substantial compared to the  
38 amount of habitat currently available in combination with the amount of new habitat that would  
39 result from restoration under Alternative 1A. The direct effects of underwater construction noise on  
40 delta smelt could be a significant impact if delta smelt are exposed because of the high likelihood  
41 that it would cause injury or death to some fish in the immediate vicinity of the activity. However,  
42 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for  
43 effects from underwater noise and would reduce the severity of impacts to a less-than-significant  
44 level.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           BDCP proponents will include specification in any construction contracts involving the  
4           installation of in-water or nearshore pilings, that piles will be installed using vibratory methods,  
5           or other non-impact driving methods, wherever feasible. Such methods have been shown to  
6           effectively minimize physical or substantial behavioral effects on fish and other aquatic species.  
7           The method selected will be based on geotechnical studies that will be conducted to determine  
8           the feasibility of vibratory installation of sheet pile, intake pipe foundation piles, and dock piles  
9           for barge landings. Where impact pile driving is required, DWR will monitor underwater sound  
10          levels to determine compliance with the underwater noise effects thresholds at a distance  
11          appropriate for protection of the species (183 dB SEL<sub>cumulative</sub> for fish less than 2 grams; 187 dB  
12          SEL<sub>cumulative</sub> for fish greater than 2 grams). Based on the results of the geotechnical evaluations, a  
13          noise monitoring plan will be prepared which will specify where and how underwater sound  
14          levels will be measured, how data will be analyzed and reported to the resource agencies, and  
15          what corrective actions will be taken should the thresholds be exceeded.

16          Baseline underwater sound measurements will be collected prior to impact pile driving. A  
17          subsample of impact driven piles will be monitored to determine actual sound levels produced.  
18          Should the sound levels exceed the thresholds, corrective actions could range from reporting to  
19          reducing the number of piles that can be impact driven in a day.

20          **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
21          **and Other Construction-Related Underwater Noise**

22          This mitigation measure would primarily apply to pile driving related to temporary barge  
23          landing construction, where the attenuation device can effectively surround or isolate the  
24          individual piles needed at these locations. This measure would not be applicable to sheet pile  
25          installations, where it would not be feasible to surround the entire sheet pile wall, although it  
26          would apply to any site where individual piles are driving with an impact hammer.

27          BDCP proponents will work with contractors to minimize pile driving, particularly impact pile  
28          driving, by using floating docks instead of pile-supported docks, wherever feasible considering  
29          the load requirements of the landings and the site conditions. If pile supported docks are  
30          required, the minimum number of piles to safely support the docks will be used. If dock piles for  
31          barge landings cannot be installed using vibratory methods, attenuation devices (e.g., isolation  
32          casings or bubble curtains) will be used to reduce the area that would be exposed to underwater  
33          sound levels above the SEL<sub>cumulative</sub> effects thresholds (183 dB SEL<sub>cumulative</sub> for fish less than 2  
34          grams are present; 187 dB SEL<sub>cumulative</sub> for fish greater than 2 grams). Baseline underwater  
35          sound measurements will be collected prior to impact pile driving. A subset of impact driven  
36          piles will be monitored to determine actual sound levels produced. Should the sound levels  
37          exceed the thresholds, corrective actions could range from reporting to reducing the number of  
38          piles that can be impact driven in a day.

39          If dock piles for barge landings cannot be installed using vibratory methods, attenuation devices  
40          (e.g., isolation casings or bubble curtains) will be used to reduce the area that would be exposed  
41          to underwater sound levels above the SEL<sub>cumulative</sub> injury thresholds.

## 1 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

2 Once constructed, Alternative 1A structures and facilities will require ongoing periodic maintenance  
3 that includes in-water work activities with the potential to affect delta smelt. These activities include  
4 periodic cleaning and replacement of screens, trash racks, and associated machinery and dredging  
5 to maintain intake capacity. These activities will produce disturbance and underwater noise, and  
6 may generate turbidity or other water quality effects. In general, the likelihood of adverse effects on  
7 delta smelt from maintenance activities would be avoided and minimized through the same  
8 methods and rationale described for Impact AQUA-1.

### 9 ***Temporary Increases in Turbidity***

10 Maintenance activities are not likely to result in turbidity impacts sufficient to adversely affect delta  
11 smelt because smelt prefer turbid conditions and because all in-water maintenance activities would  
12 occur during approved in-water work windows, when smelt are least likely to be present near the  
13 facilities. As discussed for construction-related effects on turbidity (Impact AQUA-1), the potential  
14 for delta smelt to be near the intakes during the expected in-water work window of June 1 to  
15 October 31 is low. Turbidity impacts during maintenance would be minimized by implementing the  
16 environmental commitments described under Impact AQUA-1 and in Appendix 3B, *Environmental*  
17 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
18 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
19 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
20 *and Salvage Plan; and Barge Operations Plan)*. Pertinent details of these plans are provided under  
21 Impact AQUA-1. These measures, in combination with the naturally high tolerance of delta smelt for  
22 turbidity, would be expected to effectively avoid potential adverse effects.

### 23 ***Accidental Spills***

24 Maintenance activities such as dredging, levee repair and placement of riprap involve the use of  
25 heavy equipment in the aquatic environment. Accidental spills of fuel or leakage of fluids and  
26 lubricants creates a potential pathway for the introduction of toxic substances into the aquatic  
27 environment. However, adverse effects on delta smelt from accidental spills associated with  
28 maintenance are considered unlikely based on the same rationale discussed for construction-related  
29 spill effects on delta smelt (see Impact AQUA-1). Implementation of environmental commitments  
30 described in Impact AQUA-1 (*Environmental Training; Stormwater Pollution Prevention Plan; Erosion*  
31 *and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment,*  
32 *and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and*  
33 *Barge Operations Plan)*, and specifically the *Spill Prevention, Containment, and Countermeasure Plan*  
34 (see Appendix 3B, Environmental Commitments) would be expected to minimize the potential for  
35 introduction of contaminants to surface waters and provide for effective containment and cleanup  
36 should accidental spills occur. Pertinent details of these plans are provided under Impact AQUA-1.

### 37 ***Underwater Noise***

38 Maintenance activities would be unlikely to result in underwater noise level sufficient to adversely  
39 affect delta smelt. Maintenance activities that require in-water work include cleaning trash racks,  
40 checking and cleaning intake screens, and occasional maintenance dredging. These activities could  
41 involve divers and surface equipment such as boats and barges that may temporarily elevate  
42 underwater noise levels above ambient conditions.

1 However, the resulting noise levels are not expected to reach a level that would harm juvenile or  
2 adult fishes. Routine maintenance activities of this kind typically produce noise levels below the  
3 behavioral effects threshold (150 dB RMS). NMFS (2001) has determined that underwater sound  
4 pressure levels less than 150 dB RMS may temporarily alter fish behavior but do not result in  
5 permanent harm or injury.

#### 6 ***Maintenance-Related Disturbance***

7 Bank, bed and water column disturbance associated with maintenance activities have a similar  
8 potential to cause direct injury and mortality of delta smelt. Effects of this severity would be most  
9 likely to occur during maintenance dredging activities around the new intakes. Suction dredging,  
10 mechanical excavation, and possible front-end loading equipment could entrain or crush fish,  
11 causing injury or mortality. While these mechanisms are possible, the likelihood of smelt exposure  
12 would be low due to the nature of the affected habitats and the timing of maintenance activities.  
13 Delta smelt use main channel areas and the upper water column, which limits exposure to suction  
14 dredging. Moreover, dredging activities would be limited to periods when delta smelt are least likely  
15 to be present in the affected habitats. Collectively, this would be expected to significantly reduce  
16 exposure potential.

17 The potential effects of in-water maintenance activities would be similar to those discussed for  
18 construction-related effects on delta smelt (see discussion under Impact AQUA-1). Effects would be  
19 minimized by implementation of environmental commitments described under Impact AQUA-1 and  
20 in Appendix 3B, *Environmental Commitments*. These environmental commitments include  
21 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
22 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;*  
23 *Dispose of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan;* and  
24 *Barge Operations Plan.*

#### 25 ***Loss of Spawning, Rearing, or Migration Habitat***

26 Two maintenance activities, dredging and riprap placement, would reduce habitat values in the area  
27 around the intakes. Delta smelt may currently use the habitat near the proposed locations of the  
28 intake structures for migration, spawning, and short-term larval rearing. Offshore waters would be  
29 unaffected by dredging or riprap placement. Available rearing and migration habitat of similar  
30 quantity and quality in other locations would be readily accessible to delta smelt. Effects would be  
31 minimized by implementation of environmental commitments described under Impact AQUA-1 and  
32 in Appendix 3B, *Environmental Commitments*. These environmental commitments include  
33 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
34 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;* and  
35 *Dispose of Spoils, Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans are  
36 provided under Impact AQUA-1.

#### 37 ***Predation***

38 Maintenance activities would be unlikely to have any measurable effect on system-wide delta smelt  
39 predation rates. These activities may include the use of barges and other watercraft that could  
40 theoretically provide cover, shelter, and perching areas for delta smelt predators. However, the  
41 limited duration of maintenance activities and the associated noise and disturbance would be  
42 expected to dissuade predators from concentrating at sufficient density to measurably affect

1 predation rates on delta smelt. Further, during the established work windows, few delta smelt are  
2 expected to occur during in the areas where water diversion facility maintenance would occur.

### 3 **Summary**

4 Alternative 1A would necessarily include a range of ongoing periodic maintenance activities with  
5 the potential to adversely affect delta smelt. In general, any effects that occur would be similar in  
6 nature to, but less intensive and extensive than, the range of effects described for construction  
7 activities. Implementation of the environmental commitments described in Appendix 3B,  
8 *Environmental Commitments*, would be expected to effectively avoid and minimize adverse effects  
9 on delta smelt by limiting hazardous material spills, and by rapid and effective response to spills  
10 should they occur. These include environmental commitments: *Environmental Training; Stormwater*  
11 *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*  
12 *Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel*  
13 *Material, and Dredged Material.*

14 **NEPA Effects:** Implementation of these environmental commitments, along with the low numbers of  
15 delta smelt expected to occur in the maintenance areas during the approved in-water work windows  
16 and the limited frequency and duration of in-water maintenance activities would result in a very low  
17 potential for adverse effects on delta smelt. In addition, little or no spawning habitat occurs in the  
18 areas potentially affected by maintenance activities. As a result, the effects on delta smelt from  
19 short-term maintenance activities would not be adverse.

20 **CEQA Conclusion:** Delta smelt inhabit naturally turbid water and are not expected to be affected by  
21 temporary increases in turbidity during maintenance activities. In addition to the limited frequency  
22 and duration of in-water maintenance activities and implementation of the commitments identified  
23 above and described in detail in Appendix 3B, *Environmental Commitments*, would minimize the  
24 potential for maintenance activities to affect delta smelt by limiting turbidity increases, by limiting  
25 hazardous material spills, and by rapid and effective response to spills should they occur. These  
26 commitments include *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and*  
27 *Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
28 *Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material.*  
29 Potential changes to habitat would also be limited and temporary. Therefore, the potential impact of  
30 maintenance activities is considered less than significant because it would not substantially reduce  
31 delta smelt habitat, restrict its range, or interfere with its movement. Consequently, no mitigation  
32 would be required.

### 33 **Water Operations of CM1**

34 Delta smelt would be exposed to a range of operational effects under Alternative 1A, including the  
35 operation of existing and newly constructed water diversion and distribution systems.

### 36 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

#### 37 ***Water Exports from SWP/CVP South Delta Facilities***

38 Analysis of potential entrainment at the south Delta facilities under the action alternatives was  
39 estimated with the OMR proportional entrainment loss regression (Kimmerer 2008 and 2011). The  
40 full entrainment analysis method is detailed in the *BDCP Effects Analysis – Appendix 5.B,*  
41 *Entrainment, (B.5.5.1 Proportional Entrainment Loss Regressions: Delta Smelt and Section; Section*

1 *B.6.1.5 Delta Smelt, hereby incorporated by reference*). It should be noted that simulations of  
2 entrainment increased under model simulations of future conditions (NAA), most notably in wet,  
3 above-normal and below-normal water years. This was primarily a result of X2 moving upstream  
4 with sea level rise, resulting in more delta smelt larvae/juveniles being susceptible to entrainment  
5 by the south Delta export facilities for any given OMR flow, using this method. In order to account  
6 for climate change effects and isolate the effect of alternative operational scenarios, comparisons are  
7 discussed only for similar time periods (NAA versus A1A\_LLT).

8 Alternative 1A would result in lower overall entrainment of delta smelt than the NAA (Figure 11-1A-  
9 1 and Figure 11-1A-2).

10 For larvae and juveniles (March-June), average proportional entrainment loss across all years under  
11 Alternative 1A was fairly similar to NAA, with 0.003 less entrainment (i.e., 0.3% of juvenile  
12 population, a 2% relative decrease) (Table 11-1A-1). Predicted larval/juvenile entrainment would  
13 decrease in wetter years (0.015–0.020 less, a 13–31% relative decrease) compared to NAA, but  
14 would increase 0.007–0.013 (a 4–6% relative increase) in below-normal, dry and critical years. This  
15 is due to Alternative 1A operations that result in reduced Old and Middle River flows in April and  
16 May.

17 For adult smelt under Alternative 1A, estimated average proportional entrainment across all years  
18 would be 0.021 less (a 28% relative decrease) compared to NAA. Proportional entrainment would  
19 decrease 0.016–0.04 under Alternative 1A in wet (59% relative decrease), above-normal (37%  
20 relative decrease) and below-normal (20% relative decrease) water years, and would be similar to  
21 the NAA in drier years (2–6% relative decrease).

22 Implementation of reduced negative OMR flows under the USFWS (2008) BiOp has considerably  
23 limited entrainment loss of adult delta smelt (Smelt Working Group 2010; U.S. Fish and Wildlife  
24 Service 2011). The reduced negative OMR flows aim to keep proportional adult entrainment loss  
25 below around 0.05 or 5% of the population (U.S. Fish and Wildlife Service 2008). These regulatory  
26 limits would be expected to remain in place under Alternative 1A, but the diversion rate in the South  
27 Delta would decrease as withdrawals were shifted to the Sacramento River intakes. This would  
28 result in higher OMR flows in winter and early spring (December–March) that would be expected to  
29 maintain or reduce the already low baseline-level of adult delta smelt entrainment in the south  
30 Delta.

1 **Table 11-1A-1. Differences in Proportional Entrainment of Delta Smelt at SWP/CVP South Delta**  
2 **Facilities**

Water Year	Proportional Entrainment <sup>a</sup>	
	Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>Total Population</b>		
Wet	-0.035 (-32%)	-0.060 (-45%)
Above Normal	-0.016 (-10%)	-0.044 (-23%)
Below Normal	0.021 (10%)	-0.008 (-3%)
Dry	0.027 (10%)	0.008 (3%)
Critical	0.011 (3%)	0.011 (4%)
All Years	-0.002 (-1%)	-0.024 (-11%)
<b>Juvenile Delta Smelt (March–June)</b>		
Wet	0.006 (17%)	-0.020 (-31%)
Above Normal	0.014 (18%)	-0.015 (-13%)
Below Normal	0.039 (28%)	0.007 (4%)
Dry	0.033 (18%)	0.012 (6%)
Critical	0.018 (7%)	0.013 (5%)
All Years	0.021 (17%)	-0.003 (-2%)
<b>Adult Delta Smelt (December–March)</b>		
Wet	-0.041 (-59%)	-0.040 (-59%)
Above Normal	-0.031 (-38%)	-0.030 (-37%)
Below Normal	-0.018 (-22%)	-0.016 (-20%)
Dry	-0.006 (-8%)	-0.005 (-6%)
Critical	-0.007 (-9%)	-0.001 (-2%)
All Years	-0.023 (-30%)	-0.021 (-28%)

Shading indicates >5% or more increased entrainment.

Note: Negative values indicate lower entrainment loss under Alternative than under existing biological conditions.

<sup>a</sup> Proportional entrainment index (U.S. Fish and Wildlife Service 2008).

<sup>b</sup> Adult proportional entrainment adjusted according to Kimmerer (2011).

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 Entrainment of delta smelt larvae at the north Delta intakes occurs only under the action  
6 alternatives, including Alternative 1A, because there are no north Delta intakes operational under  
7 Existing Conditions or the No Action Alternative. Entrainment risk of delta smelt under Alternative  
8 1A is assumed to be low because delta smelt are thought to spawn only infrequently in the vicinity of  
9 the proposed north Delta intake facilities sites, based on survey data (CDFW Spring Kodiak Trawl  
10 and USFWS beach seining) and a review of literature (California Department of Fish and Game  
11 2012a, Merz et al. 2011, and Moyle 2002). However, delta smelt may occur in this area under future  
12 climate conditions, if sea level rise induces movement of the spawning population farther upstream  
13 than is currently typical. The planned restoration of the Cache Slough complex under Alternative 1A  
14 is anticipated to increase the tidal excursion into Cache Slough and decrease the tidal excursion into  
15 this reach of the Sacramento River to help maintain positive flows at Georgiana Slough (*BDCP Effects*

1 *Analysis – Appendix 5.C, Flow, Passage, Salinity and Turbidity*) This is also expected to induce adult  
2 delta smelt to migrate preferentially into Cache Slough over the Sacramento River, reducing the  
3 likelihood that relative numbers of spawners will increase in the vicinity of the NDDs in response to  
4 climate change.

5 Larval entrainment was estimated using particle tracking modeling. As described in *BDCP Effects*  
6 *Analysis – Appendix 5.B Entrainment, Section B.6.1.5 Delta Smelt (hereby incorporated by reference)*,  
7 17 particle tracking model (PTM) runs were created using representative hydroperiods (e.g., Delta  
8 outflow May 1966) matched to suitable larval delta smelt starting distributions based on the CDFW  
9 20mm larval survey (1997–2010). Potential entrainment at the north Delta intakes under  
10 Alternative 1A ranged from 0 to 2% based on the PTM results, with entrainment generally less than  
11 0.1% under most hydrologic scenarios. The results were virtually identical between 30-day and 60-  
12 day particle tracking durations.

13 In recognition of the potential for smelt to occur near the north Delta intake facilities, the diversions  
14 will incorporate screens that meet design specifications developed to reduce the risks of  
15 entrainment and impingement. The screens would be expected to effectively exclude juvenile and  
16 adult delta smelt longer than 20 mm standard length (SL) (*BDCP Effects Analysis – Appendix 5.B*  
17 *Entrainment, Section B.5.9.2.1 Screening Effectiveness Analysis, hereby incorporated by reference*). Fish  
18 below 20 mm would be susceptible to entrainment (Swanson et al. 2005; Young et al. 2010 ; White  
19 et al. 2007); larger larvae would be less likely to become entrained but could be impinged on the  
20 screens. The project's adaptive management plan includes monitoring the screens to determine  
21 their effectiveness. If the screens are not meeting expectations, additional measures may be  
22 implemented to improve screen performance. These measures could include modifications to the  
23 screens or other structural components at the intakes, or changes in water diversion operations to  
24 reduce entrainment or impingement rates.

#### 25 ***Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct***

26 Establishment of a dual diversion system for the NBA, with combined operations of a new intake on  
27 the Sacramento River (operated in conjunction with proposed BDCP north Delta facilities) and the  
28 existing intake at Barker Slough, would further reduce the level of entrainment of delta smelt by  
29 removing most of the export pumping from the Barker Slough facility to the new Sacramento River  
30 facility, located in a region where delta smelt are not commonly found.

31 Larval entrainment at NBA was estimated using particle tracking modeling. As described in *BDCP*  
32 *Effects Analysis – Appendix 5.B Entrainment, Section B.6.1.5 Delta Smelt (hereby incorporated by*  
33 *reference)*, 17 particle tracking model (PTM) runs were created using representative hydroperiods  
34 (e.g., Delta outflow May 1966) matched to suitable larval delta smelt starting distributions based on  
35 the CDFW 20mm larval survey (1997–2010). Larval entrainment as modeled by PTM was low,  
36 averaging 1.3% under Alternative 1A compared to 2.0% under NAA, or 34% lower in relative terms  
37 (Table 11-1A-2). The results were virtually identical between 30-day and 60-day particle tracking  
38 durations. Entrainment risk for juvenile and adult delta smelt would be minimized with state-of-the-  
39 art screens on the existing and planned intakes.

1 **Table 11-1A-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt**  
2 **Entrained by the North Bay Aqueduct under Alternative 1A and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A1A_LL1	A1A_LL1 vs. EXISTING CONDITIONS	A1A_LL1 vs. NAA
2.1	2.0	1.3	-0.79 (-38%)	-0.69 (-34%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario

3

4 ***Predation Associated with Entrainment***

5 Pre-screen losses of delta smelt at the SWP/CVP south Delta facilities are believed to be high and are  
6 generally attributed to increased risk of predation and other unfavorable habitat conditions near the  
7 pumps (Castillo et al. 2012). Under Alternative 1A, the risk of pre-screen losses at the south Delta  
8 facilities would be reduced commensurate with the reductions in entrainment described above.  
9 Predation loss at the north Delta intakes may occur but would be limited because few delta smelt  
10 are anticipated to occur that far upstream.

11 ***NEPA Effects:*** In conclusion, under Alternative 1A, proportional entrainment and associated  
12 predation loss of delta smelt is expected to decrease overall at the south Delta facilities. The  
13 predicted reductions in entrainment in the south Delta and NBA are expected to exceed any  
14 potential entrainment-related loss that would occur at the new screened Sacramento River  
15 diversions in the north Delta. Therefore, the effect of Alternative 1A on entrainment loss would not  
16 be adverse to delta smelt and may provide a slight benefit.

17 ***CEQA Conclusion:*** As described above, implementation of OMR flows under the USFWS (2008) BiOp  
18 has considerably limited entrainment loss of adult delta smelt. Average proportional entrainment  
19 across all water years at the south Delta facilities under Alternative 1A would be reduced for adult  
20 delta smelt (0.023 less, a 30% relative decrease), but increased for larvae and juveniles (0.021 more,  
21 a 17% relative increase) compared to the Existing Conditions, which does not include the effects of  
22 climate change (Table 11-1A-1). The impact would be less than significant due to the small  
23 proportion (0.021 or 2%) of the larval/juvenile population affected.

24 It is worth considering how this result differs from the NEPA conclusion set forth above. Under the  
25 CEQA analysis, Alternative 1 could substantially increase larval/juvenile proportional entrainment  
26 relative to Existing Conditions. However, this interpretation of the biological modeling results is  
27 likely attributable to different modeling assumptions for four factors: sea level rise, climate change,  
28 future water demands, and implementation of the alternative. As discussed above (Section 11.3.3),  
29 because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and  
30 NEPA significance conclusions to vary between one another under the same impact discussion. The  
31 baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the  
32 action alternative and the NEPA baseline (NAA) models anticipated future conditions that would  
33 occur in 2060 (LLT implementation period), including the projected effects of climate change  
34 (precipitation patterns), sea level rise and future water demands, as well as implementation of  
35 required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Note that the analysis for  
36 larvae and juveniles includes both OMR flows and X2 as predictors of proportional entrainment;  
37 primarily because of sea level rise assumptions, X2 would be further upstream in the ELT and LLT

1 even with similar water operations, so that the comparison of Alternative 1 in the ELT and LLT to  
2 Existing Conditions is confounded.

3 Therefore, the analysis of larval/juvenile delta smelt entrainment at the south Delta SWP/CVP water  
4 export facilities is better informed by the results from the NEPA analysis presented above, which  
5 accounts for sea level rise by considering the NAA in the LLT. When climate change is factored in,  
6 larval-juvenile delta smelt entrainment is generally similar to conditions without BDCP (average  
7 entrainment is reduced by 2% in relative terms).

8 Operational activities associated with water exports from SWP/CVP north Delta intake facilities may  
9 result in an increase in entrainment or a loss of individuals for delta smelt in the north Delta (where  
10 no intakes currently exist), but the low species occurrence and compliance with CDFW fish screen  
11 criteria for delta smelt would not result in appreciably greater risk. In addition, implementing a dual  
12 conveyance for the SWP North Bay Aqueduct would also likely reduce overall entrainment in Barker  
13 Slough and have minimal risk at the screened alternative intake site on the Sacramento River. PTM  
14 modeling of potential particle entrainment would always be less under Alternative 1A compared to  
15 Existing Conditions (Table 11-1A-2).

16 Overall, the impact is considered less than significant because of the small proportion of the juvenile  
17 population that would be affected at the south Delta facilities and because of the potential for a  
18 reduction in adult entrainment. Furthermore, any potential impacts would be reduced by  
19 monitoring and adaptive management by the Real-Time Response Team. Consequently, no  
20 mitigation would be required.

#### 21 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 22 **Delta Smelt**

23 Flows affect the amount of spawning habitat available to delta smelt (Hobbs et al. 2005; 2007),  
24 although spawning habitat is not known to be limited. The spawning habitat preferences of delta  
25 smelt are currently unknown, but areas with sandy substrates are known to be important for  
26 spawning of other smelt species (Sommer and Mejia 2013). Flow reductions below the north Delta  
27 intake facilities on the Sacramento River would not reduce spawning habitat in the sandy beaches of  
28 sloughs and channel edges used by delta smelt, as suggested by modeling of bench inundation  
29 (detailed in *BDCP Effects Analysis- Appendix 5.C Flow, Section 5C.4.4.3 Wetland Bench Inundation,*  
30 *hereby incorporated by reference*). Furthermore, there is little evidence that the delta smelt  
31 population is limited by availability of suitable spawning habitat.

32 Water temperature is a cue for spawning timing for delta smelt. In-Delta water temperatures are  
33 primarily affected by atmospheric conditions such as solar radiation, air temperature, and wind.  
34 Water temperatures are typically in thermal equilibrium with atmospheric conditions and would  
35 not be strongly influenced by the flow changes under Alternative 1A. The modeling results indicate  
36 no biologically significant changes in water temperature within the Delta under Alternative 1A and  
37 no substantial changes in the median spawning day of the year, or number of stressful or lethal  
38 condition days for juveniles (detailed in *BDCP Effects Analysis -Appendix 5.C, Flow, Attachment 5.C.C,*  
39 *Water Temperature, hereby incorporated by reference*).

40 **NEPA Effects:** The overall effect on delta smelt spawning habitat would not be adverse, because  
41 there would be little change in suitable abiotic spawning conditions under Alternative 1A.

1 **CEQA Conclusion:** Flow reductions below the north Delta intake facilities on the Sacramento River  
2 would not reduce spawning habitat in the sandy beaches of sloughs and channel edges used by delta  
3 smelt, and very little change in spawning timing is expected based on temperature. Therefore, this  
4 impact is considered less than significant, because there would be no substantial reduction in  
5 spawning habitat or spawning timing. Consequently, no mitigation would be required.

#### 6 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

7 Larval and juvenile delta smelt generally rear throughout the west Delta, Suisun Bay, Suisun Marsh,  
8 and in Cache Slough. Other areas in the Delta may also be used for rearing. The extent of abiotic  
9 habitat for delta smelt in the fall (September–December, the older juvenile rearing and maturation  
10 period) as a function of changes in flows was assessed using a technique based on the method of  
11 Feyrer and coauthors (2011) (as detailed in *BDCP Effects Analysis –Appendix 5.C, Flow, Section*  
12 *5C.5.4.5.1 Delta Smelt Fall Abiotic Habitat Index hereby incorporated by reference. BDCP Effects*  
13 *Analysis –Appendix 5.E Habitat Restoration* presents additional analyses of effects on delta smelt  
14 related to juvenile habitat).

15 Feyrer and coauthors (2011) demonstrated that X2 in the fall correlates nonlinearly with an index of  
16 delta smelt abiotic habitat in the West Delta, Suisun Bay, and Suisun Marsh subregions, as well as  
17 smaller portions of the Cache Slough, South Delta, and North Delta subregions (see Figure 3 of  
18 Feyrer et al. 2011). Investigations in recent years have indicated that delta smelt occur year-round  
19 in the Cache Slough subregion, including Cache Slough, Liberty Island, and the Sacramento Deep  
20 Water Ship Channel (Baxter et al. 2010; Sommer et al. 2011). Whether the same individuals are  
21 residing in these areas for their full life cycles or different individuals are moving between upstream  
22 and downstream habitats is not known (Sommer et al. 2011). The delta smelt fall abiotic habitat  
23 index is the surface area of water in the west Delta, Suisun Bay, and Suisun Marsh (as well as smaller  
24 portions of the Cache Slough, South Delta, and North Delta subregions) weighted by the probability  
25 of presence of delta smelt based on water clarity (Secchi depth) and salinity (specific conductance)  
26 in the water. Feyrer and coauthors' (2011) method found these two variables to be significant  
27 predictors of delta smelt presence in the fall. They also concluded that water temperature was not a  
28 predictor of delta smelt presence in the fall, although it has been shown to be important during  
29 summer months (Nobriga et al. 2008).

30 Investigations in recent years have indicated that delta smelt occur year-round in the Cache Slough  
31 subregion, including Cache Slough, Liberty Island, and the Sacramento Deep Water Ship Channel  
32 (Baxter et al. 2010; Sommer et al. 2011). The degree of individual movement between upstream and  
33 downstream habitats has not been confirmed (Sommer et al. 2011), although emerging evidence  
34 suggests that a substantial fraction of the fish occurring in the upstream areas are residing there  
35 throughout the year (Hobbs in prep.).

36 It is worth noting that the National Research Council (2010) discussed some potential limitations of  
37 USFWS' (2008) analysis of fall habitat suitability and the potential implications of using linked  
38 correlations for quantitative conclusions. Nevertheless, this method was applied (in a modified  
39 form) in the BDCP and therefore is included in this analysis of relative comparisons between action  
40 alternatives and baseline conditions.

41 **NEPA Effects:** If it were assumed that BDCP habitat restoration did not produce the intended  
42 benefits to delta smelt, the abiotic habitat index under Alternative 1A flows averaged across all years  
43 would decrease 22% compared to NAA, with the greatest reductions in above normal (27%  
44 decrease) and wet (41% decrease) water years (Figure 11-1A-3, Table 11-1A-3). However,

1 assuming the intended habitat benefits are realized, the abiotic habitat index under Alternative 1A  
2 averaged across all years would be similar to baseline conditions, though it would decrease 26% in  
3 wet years and increase 16% in below normal years compared to the NAA (Table 11-1A-3). The  
4 reduction in abiotic habitat index in Alternative 1A results from Operational Scenario A, which does  
5 not include Fall X2 requirements, while the NAA does.

6 **Table 11-1A-3. Delta Smelt Fall Abiotic Index (hectares), Averaged by Water Year Type, with and**  
7 **without Restoration (100% Occupancy Assumed) under Alternative 1A**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
All	-168 (-4%)	-1,053 (-22%)	840 (21%)	-46 (-1%)
Wet	-666 (-14%)	-2,862 (-41%)	390 (8%)	-1,806 (-26%)
Above Normal	170 (4%)	-1,498 (-27%)	1,416 (37%)	-251 (-5%)
Below Normal	-23 (-1%)	125 (3%)	496 (12%)	644 (16%)
Dry	108 (3%)	199 (6%)	133 (4%)	224 (6%)
Critical	21 (1%)	20 (1%)	1,832 (61%)	1,832 (61%)

Note: Negative values indicate lower habitat indices under Alternative 1A. Water year 1922 was omitted because water year classification for prior year was not available.

8

9 Tidal habitat restoration under *CM4 Tidal Natural Communities Restoration* is intended to provide  
10 suitable rearing habitat adjacent to areas currently occupied by delta smelt, including in Suisun  
11 Marsh, Suisun Bay, the west Delta, and Cache Slough. Using a habitat suitability index for the entire  
12 Delta, analysis of larval and juvenile delta smelt habitat suitability in the ROAs indicates that  
13 Alternative 1A could result in considerably more habitat for delta smelt than currently exists (see  
14 *BDCP Effects Analysis – Appendix 5.E Habitat Restoration, Section E.4.2, hereby incorporated by*  
15 *reference*). In addition, *CM2 Yolo Bypass Fisheries Enhancement* may export food resources that  
16 benefit spawning adults and larvae (see discussion under *Impact AQUA-9 Effects of restored habitat*  
17 *conditions on delta smelt*). Habitat suitability may decrease slightly for larval delta smelt over time,  
18 and more so for juvenile delta smelt because of temperature and other effects associated with  
19 climate change during the summer and fall and uncertainty related to future trends in turbidity  
20 (Brown et al. 2013), but the predicted overall increases in habitat quantity are greater than  
21 decreases in quality. Use of restored areas by delta smelt will depend on the habitat characteristics  
22 within the habitats (e.g., the extent of tidal excursion and velocity, temperature, and turbidity)  
23 (Sommer and Mejia 2013). With sea level rise and increasing salinity, there may be greater  
24 occupation of upstream areas by delta smelt, in which case habitat restoration in the Cache Slough  
25 and West Delta ROAs would gain importance.

26 The restored areas may also provide additional food production and export to rearing areas which  
27 would be beneficial to delta smelt, particularly from the Suisun Marsh, West Delta, and Cache Slough  
28 ROAs which are closer to the species main range. A decrease in food resources (principally calanoid  
29 copepods) has been linked to declines in delta smelt abundance in several studies. Kimmerer (2008)  
30 demonstrated a strong positive correlation between survival of juvenile delta smelt from summer to  
31 fall and density of calanoid copepods during that period. Miller et al. (2012) found that minimum  
32 density of the calanoid copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi* during the spring  
33 delta smelt larval period (April–June) and average density of *E. affinis* and *P. forbesi* during the fall

1 (September–December) were significantly related to interannual trends in fall delta smelt relative  
 2 abundance. Maunder and Deriso (2010) found that April–June minimum density of *E. affinis* and *P.*  
 3 *forbesi* before the larval life stage and July–August average density of *E. affinis* and *P. forbesi* after the  
 4 juvenile life stage (July–August) were important factors associated to changes in delta smelt  
 5 abundance in their life cycle model. Mac Nally et al. (2010) found some statistical evidence that  
 6 summer calanoid copepod density was associated with annual trends in abundance of delta smelt in  
 7 the fall. The decrease in food resources may have been because of a factor such as a change in  
 8 phytoplankton and zooplankton assemblages related to biological invasions (e.g., the invasive clam  
 9 *Corbula amurensis*) (Winder and Jassby 2011) and anthropogenic factors such as nutrient balance  
 10 (Dugdale et al. 2007; Glibert et al. 2011).

11 **CEQA Conclusion:** Under Alternative 1A, rearing habitat as indicated by the abiotic habitat index  
 12 would be similar to Existing Conditions across all years, as neither Alternative 1A nor Existing  
 13 Conditions include Fall X2 criteria. Habitat restoration under *CM4 Tidal Natural Communities*  
 14 *Restoration* is intended to provide an overall increase in suitable rearing habitat adjacent to areas  
 15 currently occupied by delta smelt (see discussion under Impact AQUA-9 *Effects of restored habitat*  
 16 *conditions on delta smelt*), while restored areas from *CM5 Seasonally Inundated Floodplain*  
 17 *Restoration* and *CM2 Yolo Bypass Fisheries Enhancement* may provide additional food production and  
 18 export to rearing areas that would be beneficial to delta smelt—particularly from the Suisun Marsh,  
 19 West Delta, and Cache Slough ROAs which are closer to the species main range. Assuming the  
 20 restored areas are fully occupied by delta smelt, the abiotic habitat index would increase 21%  
 21 compared to Existing Conditions. Overall, there would be a minor beneficial impact on the species  
 22 compared to Existing Conditions without Fall X2, primarily from implementation of the restoration.  
 23 Therefore, the impacts of project operations are considered less than significant because they would  
 24 not substantially reduce rearing habitat. Further, restoration components of Alternative 1A are  
 25 intended to increase rearing habitat for delta smelt. Consequently, no mitigation would be required.

#### 26 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

27 From December to March, many mature delta smelt migrate upstream from brackish rearing areas  
 28 in and around Suisun Bay and the confluence of the Sacramento and San Joaquin Rivers (U.S. Fish  
 29 and Wildlife Service 2008a; Sommer et al. 2011). The initiation of migration is associated with  
 30 pulses of freshwater inflow, which are turbid, cool, and less saline (Grimaldo et al. 2009). Changes in  
 31 flow under Alternative 1A could change turbidity, but is not expected to result in changes in water  
 32 temperatures or pulses of local rainwater into the Delta. As described above in Impact AQUA-4, in-  
 33 Delta water temperatures would not change in response to Alternative 1A flows. The modeling  
 34 results indicate no biologically meaningful changes in water temperature within the Delta under  
 35 Alternative 1A and no substantial changes in the number of stressful or lethal condition days for  
 36 juveniles.

37 Turbid water is an important habitat characteristic for delta smelt (Nobriga et al. 2008; Feyrer et al.  
 38 2011), and has been correlated to long-term changes in delta smelt abundance or survival either by  
 39 itself or in combination with other factors (Thomson et al. 2010; Miller et al. 2012). Therefore, it is  
 40 assumed that turbidity is an attribute of critical importance to delta smelt larvae, juveniles, and  
 41 adults. Operation of the north Delta intakes (*CM1 Water Facilities and Operation*) is estimated to  
 42 result in around 8 to 9% less sediment entering the Plan Area from the Sacramento River, the main  
 43 source of sediment for the Delta and downstream subregions. In addition, there could be sediment  
 44 accretion capture in the ROAs (*CM4 Tidal Natural Communities Restoration*). Notching the Fremont  
 45 Weir (*CM2 Yolo Bypass Fisheries Enhancements*) will also direct more Sacramento River water and

1 sediment into the Bypass. These actions could limit sediment supply to areas currently important to  
2 delta smelt, such as Suisun Bay, which would result in less seasonal deposition of sediment that  
3 could be resuspended by wind-wave action to make/keep the overlying water column turbid.  
4 Therefore, there is a potential for a slight increase in water clarity, and a corresponding reduction in  
5 habitat quality for delta smelt. However, Alternative 1A is not expected to affect suspended  
6 sediment concentration during the first flush of precipitation that cues delta smelt migration. As  
7 such, turbidity cues associated with adult delta smelt migration should not change. With regard to  
8 suspended sediment concentrations at other times of the year, any effect will be minimized through  
9 the reintroduction of sediment collected at the north Delta intakes into tidal natural communities  
10 restoration projects (CM4), consistent with the Environmental Commitment addressing Disposal  
11 and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material.

12 **NEPA Effects:** Alternative 1A may decrease sediment supply to the estuary by 8 to 9 percent, with  
13 the potential for decreased habitat suitability for delta smelt in some locations.

14 **CEQA Conclusion:** Reduced flows in the Sacramento River would not substantially alter the flow or  
15 turbidity cues or water temperature that are associated with the first flush of winter precipitation  
16 and that may be associated with delta smelt migration to their spawning grounds. Therefore, water  
17 operations would not substantially interfere with the movement of delta smelt. Consequently, no  
18 mitigation would be required.

## 19 **Restoration Measures (CM2, CM4–CM7, and CM10)**

### 20 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

21 Alternative 1A includes implementation of a suite of restoration activities intended to provide  
22 suitable habitat for delta smelt and by doing so, offset and mitigate for the short- and long-term  
23 effects of this alternative on habitat conditions for delta smelt and other species of concern. The  
24 construction of these restoration measures is likely to result in a range of effects similar, but not  
25 identical to, the range of effects described for construction and maintenance of Alternative 1A  
26 facilities.

27 The primary differences between this impact category and the other construction-related impact  
28 categories is that the timing and location of these effects will be different, as determined by where  
29 the various restoration activities are located, the nature of the habitats involved, and the short-term  
30 environmental response resulting from the conversion of the affected areas to productive habitats.

#### 31 **Temporary Increases in Turbidity**

32 Restoration construction activities such as riprap removal, shoreline excavation, floodplain re-  
33 contouring, and planting riparian vegetation have the potential to result in temporary increases in  
34 turbidity in adjacent waterways. As discussed previously for Impact AQUA-1 and Impact AQUA-2,  
35 delta smelt are unlikely to be affected by temporary increases in turbidity associated with  
36 restoration activities, because delta smelt prefer turbid conditions and applicable environmental  
37 commitments will be used to keep suspended sediment levels within the current normal range.  
38 Implementation of environmental commitments described under Impact AQUA-1 and in Appendix  
39 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
40 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
41 *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*

1 *Material; Fish Rescue and Salvage Plan; and Barge Operations Plan*), would minimize changes in  
2 turbidity. Pertinent details of these plans are provided under Impact AQUA-1.

### 3 ***Increased Exposure to Mercury and Methylmercury***

4 Alternative 1A includes CM4, *Tidal Habitat Restoration*, which will restore aquatic habitats in the  
5 Delta by breaching levees and converting agricultural and other upland areas to tidal, open water,  
6 and floodplain habitats. Restoration construction activities could disturb sediments that could  
7 contain contaminants, including mercury. However, the BMPs put in place to reduce turbidity will  
8 also minimize suspension of potentially contaminated sediments. The implementation of CM12,  
9 *Methylmercury Management*, would provide for site-specific assessments of restoration areas,  
10 integration of design measures to minimize methylmercury production, and site monitoring and  
11 reporting. As a result, effects of methylmercury mobilization on covered fish at the tidal wetland  
12 restoration sites are expected to be minimized and not adverse.

### 13 ***Accidental Spills***

14 Restoration activities involve the use of heavy equipment in proximity to aquatic environments,  
15 presenting the potential for spills of fuel, fluids, and lubricants that could potentially harm aquatic  
16 species and their habitats. As discussed under Impact AQUA-1 and Impact AQUA-2, adverse effects  
17 from accidental spills will be avoided through implementation of appropriate impact avoidance and  
18 minimization measures (*Environmental Training; Stormwater Pollution Prevention Plan; Erosion and*  
19 *Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
20 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge*  
21 *Operations Plan; see Appendix 3B, Environmental Commitments and Impact AQUA-1). Specifically,*  
22 *environmental commitment Spill Prevention, Containment, and Countermeasure Plan* will be  
23 implemented to minimize the risk of spills occurring and to provide for rapid and effective response  
24 to contain any accidental spills. Therefore adverse effects from accidental spills would not be likely  
25 to occur.

### 26 ***Disturbance of Contaminated Sediments***

27 Habitat restoration activities are expected to disturb contaminated sediments in and around aquatic  
28 habitats. The types of contaminants known to exist in sediments in the Delta, and the specific  
29 biogeochemistry, potential for increased bioavailability, and potential effects on covered species  
30 from exposures, is discussed in detail in *BDCP Effects Analysis – Appendix 5.D, Contaminants, hereby*  
31 *incorporated by reference*. In general, the types of contaminants that would be bound in sediments,  
32 have a natural affinity for sediments, so only limited amounts will become soluble when sediments  
33 are disturbed. These contaminants include metals, polychlorinated biphenyls (PCBs), and many  
34 types of pesticides. Thus, sediment disturbance may result in an increase in suspended particulates  
35 that could contain contaminants, with limited and temporary increases in contaminants dissolved in  
36 the water column. A possible exception would be if sediments were contaminated with a light oil  
37 mixture that could contain some lighter, more soluble components.

38 Implementation of BMPs to reduce turbidity, as discussed above, will also minimize the potential for  
39 suspension of contaminated sediments in the water column.

40 Any delta smelt that occupy areas near restoration sites that are under construction may be exposed  
41 to elevated contaminant concentrations, including bioavailable mercury. This may have negative  
42 impacts to some individual fishes, but individual restoration construction activities will be of short

1 duration and it is not expected that they will cause population-level impacts to delta smelt viability  
2 or change the average contaminant body burdens accumulated by delta smelt during their life cycle.  
3 Thus, the effect of restoration construction would not be adverse under Alternative 1A compared to  
4 the NAA. Further, implementation of environmental commitments described in Appendix 3B,  
5 *Environmental Commitments, (Environmental Training; Stormwater Pollution Prevention Plan;*  
6 *Erosion and Sediment Control Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
7 *Material; and Barge Operations Plan)* would minimize the potential for resuspended contaminants to  
8 affect delta smelt. Pertinent details of these plans are provided under Impact AQUA-1.

### 9 ***In-Water Work Activities***

10 Restoration construction activities could temporarily produce noise levels and disturbances that  
11 could affect nearby fishes. However, these restoration construction activities do not include pile  
12 driving, which is the primary activity likely to produce underwater sound levels that could reach  
13 threshold levels capable of injuring or killing fish. Potential effects of in-water activity would be  
14 minimized by implementation of the environmental commitments described under Impact AQUA-1  
15 and in Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment Control Plan;*  
16 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*

### 17 ***Predation***

18 Restoration construction activities would be unlikely to have any measurable effect on delta smelt  
19 predation rates. Much of the restoration construction would occur on dry land (e.g., recontouring,  
20 removing levees) which would have no in-water effects including any influence on the vulnerability  
21 of delta smelt to predators. In-water activities may include the use of barges and other watercraft  
22 that could theoretically provide cover, shelter, and perching areas for delta smelt predators.  
23 However, the limited duration of these activities and the associated noise and disturbance would be  
24 expected to dissuade predators from concentrating at sufficient density to measurably affect  
25 predation rates on delta smelt. Because silverside predation on post-hatch larval delta smelt in  
26 newly created restored tidal habitat areas remains quantified, its evaluation should become a  
27 portion of associated monitoring activities at these sites.

### 28 ***Summary***

29 In-water and shoreline restoration construction activities may result in short-term effects on delta  
30 smelt through direct disturbance, short-term water quality impacts, and increased exposure to  
31 contaminants associated with the incidental disturbance of contaminated sediments. Overall, the  
32 effect of restoration construction activities on the bioavailability of contaminants is expected to be  
33 minimal, as they would likely be localized, sporadic, and of low magnitude, and typically offset by  
34 the collective benefits of broad-scale habitat restoration. Implementation of the environmental  
35 commitments described in Appendix 3B, *Environmental Commitments*, would minimize or eliminate  
36 effects on delta smelt. The relevant environmental commitments are: *Environmental Training;*  
37 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
38 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
39 *Reusable Tunnel Material, and Dredged Material.* Pertinent details of these plans are provided under  
40 Impact AQUA-1.

41 ***NEPA Effects:*** The effects of short-term restoration construction activities would not be adverse to  
42 delta smelt.

1 **CEQA Conclusion:** Habitat restoration activities could result in short-term effects on delta smelt,  
2 primarily as a result of increased potential for contaminated sediments to enter the water column.  
3 However, these effects are likely to be localized, sporadic, and of low magnitude. Adverse effects  
4 during restoration would be avoided by limiting the frequency, duration, and spatial extent of in-  
5 water work and implementing the commitments identified above and described in detail under  
6 Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*. In contrast habitat restoration  
7 would be expected to result in a significant long-term net benefit for delta smelt by substantially  
8 increasing the quality and quantity of key habitats required by this species. The potential impact of  
9 habitat restoration activities is considered less than significant because it would not substantially  
10 reduce delta smelt habitat, restrict its range or interfere with its movement. Additionally, there  
11 would be substantial long-term net benefits of habitat restoration. Consequently, no additional  
12 mitigation would be required.

### 13 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta** 14 **Smelt**

15 Effects of implementing the habitat restoration conservation measures (CM2, CM4–CM7, and CM10)  
16 on delta smelt will depend on the life stage present in the area of elevated toxins and the duration of  
17 exposure. Formation and release of toxic constituents from sediments (e.g., in restored areas) is tied  
18 to inundation, and so highest concentrations will occur during seasonal high water and to a lesser  
19 extent for short time periods on a tidal cycle in marshes. A complete analysis can be found in the  
20 *BDCP Effects Analysis – Appendix 5D, Contaminants, hereby incorporated by reference.*

#### 21 **Mercury**

22 The analysis presented in *BDCP Effects Analysis – Appendix 5D, Contaminants, Section 5D.4.1 Mercury*  
23 *(hereby incorporated by reference)*, indicate that Alternative 1A restoration efforts have the potential  
24 to increase the exposure of fish, including delta smelt, to methylmercury produced as a result of  
25 altered geochemistry associated with inundation of restored tidal wetlands and floodplains, which  
26 are used for rearing by delta smelt. It should be noted that the primary concern for methylmercury  
27 is its bioaccumulation into piscivorous wildlife (Melwani et al. 2009; Ackerman et al. 2012) and  
28 humans (Davis et al. 2012). Forage fishes similar to delta smelt show high spatial variability in the  
29 bioaccumulation of methylmercury (Gehrke et al. 2011; Greenfield et al. 2013) as do juvenile  
30 Chinook salmon (Henery et al. 2010). It has not been demonstrated that these accumulations impair  
31 these small fishes so similar exposures in restored habitats may not affect these species' viability,  
32 though they may be of concern for passing mercury up the food web to birds and humans. The areas  
33 expected to have the highest potential for methylmercury production are the Yolo Bypass and, to a  
34 lesser extent, the Cosumnes/Mokelumne Rivers and Suisun Marsh. As described in *BDCP Effects*  
35 *Analysis – Appendix 5D, Contaminants, Section 5D.4.1 Mercury (hereby incorporated by reference)*, the  
36 amounts of methylmercury mobilized and resultant effects on covered fish species are not currently  
37 quantifiable. Slotton and others (2000: 43) noted:

38 Results to date indicate that wetlands restoration projects may result in localized mercury  
39 bioaccumulation at levels similar to, but not necessarily greater than, general levels within their  
40 surrounding Delta subregion. Nevertheless, high methylation potential, flooded wetland habitat may  
41 be the primary source of methylmercury production in the overall system...Careful monitoring will  
42 be essential to assess the actual effects of new wetlands restoration projects.

43 Although methylmercury will be produced and mobilized, *CM12 Methylmercury Management* was  
44 developed to minimize production and bioavailability of methylmercury associated with BDCP

1 restoration. CM12 requires a site specific plan for each restoration project including site sampling  
2 for mercury, post-restoration monitoring, and adaptive management, where the potential for  
3 mercury to be present is indicated. CM12 also requires integration of design elements into  
4 restoration projects to attempt to minimize methylmercury production.

5 CM12 will be developed and implemented in coordination with the California Department of Water  
6 Resources (DWR) Mercury Monitoring and Evaluation Section which is working on DWR's  
7 compliance with the requirements of the *Sacramento–San Joaquin Delta Methylmercury Total*  
8 *Maximum Daily Load* (Central Valley Regional Water Quality Control Board 2011a) and *Amendments*  
9 *to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the*  
10 *Control of Methylmercury and Total Mercury in the Sacramento–San Joaquin Delta Estuary* (Mercury  
11 Basin Plan Amendments) (Central Valley Regional Water Quality Control Board 2011b). Under  
12 Phase I of the TMDL, the DWR Mercury Monitoring and Evaluation Section is planning control  
13 studies to research and identify effective measures to mitigate methylmercury generation and  
14 mobilization in connection with restored wetlands. The results of the Phase I control studies will be  
15 integrated into BDCP restoration planning to attempt to limit methylmercury production to keep it  
16 within acceptable bounds.

17 CM12 requires that as the Phase I and Phase II TMDL programs generate information on  
18 methylmercury distribution, effects, and the performance of mitigation measures, this information  
19 be reviewed for every restoration project, and design elements and BMPs that have proven  
20 successful be incorporated into the restoration design.

21 In summary, Alternative 1A restoration actions (CM2, CM4–CM7, and CM10) are likely to result in  
22 some increased production, mobilization, and bioavailability of methylmercury in the aquatic  
23 system. Modeling of Alternative 1A water operations (CM1) effects showed little changes in  
24 methylmercury concentrations in the water. To address the issue of methylmercury production at  
25 restoration areas, management measures will be implemented through CM12.

26 The following discussion is based on the assumption that some level of methylmercury would be  
27 mobilized at BDCP ROAs.

#### 28 *Eggs*

29 Delta smelt spawn in or near areas that would be restored under Alternative 1A and therefore have  
30 the potential for increased exposure to methylmercury. Although no specific information is  
31 available, it is potentially possible that maternal transfer could occur, (i.e., prespawmed eggs could  
32 be exposed to methylmercury from adult consumption of contaminated prey). Splittail, delta smelt,  
33 and longfin smelt all spawn in or near areas that would be restored under the BDCP and therefore  
34 have the potential for increased exposure to methylmercury. For delta smelt that spawn directly  
35 downstream of the Yolo Bypass or other ROAs in the west or north Delta, exposure of prespawmed  
36 eggs to increased levels of methylmercury could affect the viability of fertilized eggs. It is not known  
37 what level of mercury would be assimilated and transferred to the larvae. Mercury exposure in eggs  
38 can lead to egg failure and developmental effects, but the levels of mercury that would result in  
39 these effects are not fully understood.

#### 40 *Larvae and Juveniles*

41 Effects of increased methylmercury are expected to be minimal for fish rearing in the Delta. Larvae  
42 and juvenile delta smelt feed very low on the food chain and would bioaccumulate methylmercury at

1 low rates. In addition, juvenile delta smelt occur primarily in the west Delta and Suisun Bay, where  
2 elevated levels of methylmercury from restoration are not likely. However, juvenile smelt remaining  
3 in the north Delta area would experience exposure from food in the Yolo Bypass and Cache Slough  
4 regions although not to levels that would have any direct effect on them.

#### 5 *Adults*

6 Although adult life stages of delta smelt feed and spawn in areas with potential for elevated  
7 methylmercury levels, they feed primarily on lower trophic level food sources and therefore do not  
8 accumulate methylmercury at rates as high as if they preyed on fish. In addition, they are not  
9 expected to spend excessive amounts of time in these areas, so the uptake through their gills and  
10 food is expected to be minimal. Nevertheless, delta smelt have been shown to accumulate  
11 appreciable quantities of mercury: Bennett et al. (2001) found average levels of 0.18 µg/g, which is  
12 just under the 0.20 µg/g general threshold for effects on fish (Henery et al. 2010:561). There is no  
13 evidence for acute toxicity of mercury being related to recent declines of pelagic fish such as delta  
14 smelt, although mercury, selenium, and copper may have chronically affected these species (Brooks  
15 et al. 2012).

#### 16 *Selenium*

17 Elevated selenium concentrations in the Delta ecosystem is widely recognized as posing a threat to  
18 aquatic species. Selenium in the Delta ecosystem and potential effects of BDCP conservation  
19 measures on covered fish species are fully described in the *BDCP Effects Analysis – Appendix 5.D,*  
20 *Contaminants, Section 5D.4.2.1 Selenium-Location, Environmental Fate, and Transport, and Appendix*  
21 *5D, Attachment 5D.B Bioaccumulation Model Development for Selenium Concentrations in Whole Body*  
22 *Fish, Bird Eggs, and Fish Filets (hereby incorporated by reference).* These effects include impaired  
23 reproduction, embryonic deformities and bioaccumulation.

24 Overall, loading of selenium to the Delta aquatic system has decreased significantly. The main  
25 controllable sources of selenium in the Bay-Delta estuary are agricultural drainage (generated by  
26 irrigation of seleniferous soils in the western side of the San Joaquin basin) and discharges from  
27 North Bay refineries (in processing selenium-rich crude oil). Both the San Joaquin River and North  
28 Bay selenium loads have declined in the last 15 years in response to, first, a control program in the  
29 San Joaquin Grassland area, and, second, National Pollutant Discharge Elimination System (NPDES)  
30 permit requirements established for refineries in the late 1990s.

31 Because the bioavailability of selenium increases in an aquatic system, inundation of ROAs could  
32 mobilize selenium sequestered in sediments and increase exposure of covered fish species. The rate  
33 at which selenium will become mobilized as part of restoration will depend on the amount of  
34 selenium stored in the sediments, the length of inundation (residence time), and whether sufficient  
35 time allows the selenium to cycle through the aquatic system and into the food chain.

36 The bioaccumulation and effects of selenium on fish have much to do with their feeding behavior.  
37 The overbite clam, *C. amurensis*, accumulates selenium and is key to mobilizing it into the food chain  
38 via benthic feeders. Delta smelt would be expected to have low exposure to selenium as they are  
39 feeding on pelagic organisms that are able to excrete most of the selenium they consume (Stewart et  
40 al. 2004).

41 In Suisun Bay, particulate concentrations of selenium (the most bioavailable) are considered low,  
42 typically between 0.5 and 1.5 micrograms per gram (µg/g), but the bivalve *Potamocorbula*

1 *amurensis* (overbite clam) contains elevated levels of selenium that range from 5 to 20 µg/g  
2 (Stewart et al. 2004). Given the fact that *Potamocorbula* may occur in abundances of up to 50,000  
3 per m<sup>2</sup>, this area can be considered a sink for selenium because 95% of the biota in some areas are  
4 made up of this clam.

5 The longer the residence time of surface waters, the higher the particulate concentration resulting in  
6 higher selenium concentrations in wetlands and shallows (Presser and Luoma 2006, 2010). Aquatic  
7 systems in shallow, slow-moving water with low flushing rates are thought to accumulate selenium  
8 most efficiently (Presser and Luoma 2006; Lemly 1999). However, the ratio of selenium in  
9 particulates (which is more bioavailable) to selenium in the water column is a complex relationship  
10 that can vary across different hydrologic regimes and seasons (Presser and Luoma 2010).

11 An increase of residence time in areas with dense clam populations (such as Suisun Bay) and  
12 benthic-feeding covered fish species, could result in increased mobilization and bioaccumulation of  
13 selenium in the food chain of benthic-feeding fish. Residence time is directly related to outflow in  
14 Suisun Bay. However, CALSIM modeling results indicate that outflow and residence time will not  
15 change significantly under Alternative 1A, and effects on selenium biogeochemical cycling are not  
16 anticipated. Comparison of the monthly mean residence time (averaged over years 1992 through  
17 2003) indicates that residence time in Suisun Bay may change from a decrease of 13 days to an  
18 increase of 5 days.

19 In summary, selenium currently sequestered in soils could be mobilized and become more  
20 bioavailable as a result of inundation of restoration areas. Because the magnitude of this  
21 mobilization and bioaccumulation of selenium would depend on the type of food sources (filter  
22 feeders vs. plankton), significant changes in residence time, and pre-existing concentrations of  
23 selenium in the specific area, effects on aquatic species would need to be determined on a site-  
24 specific basis. Given the decrease in loading of selenium to the Delta (from regulation of both  
25 Grasslands in the San Joaquin River basin and oil refineries near Suisun Bay) and that the selenium  
26 would be mobilized into the food chain under a narrow set of conditions, the overall effects within  
27 the Plan Area are likely low. The potential is highest for increased mobilization of selenium in and  
28 near the San Joaquin River and the South Delta ROAs, where selenium concentrations in soils are  
29 expected to be highest, and potentially in Suisun Bay where filter feeders are the food source for  
30 benthic-feeding covered fish species.

31 Impacts on Delta smelt from selenium are not expected from Alternative 1A restoration projects  
32 (CM2, CM4–CM7, and CM10), given that the Delta smelt planktonic food source does not efficiently  
33 accumulate selenium, limiting the exposure route. Further, overall loading of selenium to the Delta  
34 system has and will continue to significantly decrease. Added to the benefits from BDCP habitat  
35 restoration, little effects are expected from selenium on Delta smelt.

### 36 **Copper**

37 Copper is expected to be present in soils where copper-containing pesticides have been applied.  
38 Although copper is relatively immobile in terrestrial soils, its mobility increases in an aquatic system  
39 and it could be mobilized by inundation of restored habitat areas within the ROAs.

40 In general, the copper data sets discussed in Section 5.D.4.3 of the *BDCP Effects Analysis – Appendix*  
41 *5D, Contaminants, Section 5D.4.3 Copper (hereby incorporated by reference)*, indicate low levels of  
42 copper (less than 2 µg/L) throughout the Delta waterways, and elevated concentrations in  
43 agricultural drainage sloughs and near mines. Although data were not identified, it is assumed the

1 agricultural soils will contain some level of copper given its affinity for soils in a terrestrial  
2 environment. Formerly agricultural ROAs, which are likely to have elevated levels of copper in soils,  
3 will result in some level of increased copper in the aquatic system over an undetermined time  
4 period. Currently, information on the concentrations of copper in soils of specific ROAs is  
5 insufficient to estimate the increase in concentrations.

6 Additionally, restoration of agricultural land to marshes and floodplains will result in decreased  
7 application of copper-containing pesticides and decreased copper loading to the Delta. This net  
8 benefit at least partially will counter the copper introduced to the aquatic system through  
9 mobilization during inundation.

10 It is difficult to establish precise concentrations at which copper is acutely toxic to fish, as a large  
11 number of water chemistry parameters (including temperature, pH, DOC, and ions) can affect the  
12 bioavailability of copper to the fish population (U.S. Environmental Protection Agency 2007). As  
13 discussed in Section D.5.3 of *BDCP Effects Analysis – Appendix 5.D, Contaminants, Section 5.D.4.3*  
14 *Copper*, copper is present in the Sacramento River at low concentrations (2 µg/L). Connon with  
15 others (2011) demonstrated that the median lethal concentration of dissolved copper at which 10%  
16 of delta smelt juveniles died after 7 days of exposure under experimental conditions (LC10) was 9.0  
17 µg/L; 50% of juveniles died (LC50) when exposed to a median concentration of 17.8 µg/L. Although  
18 96-hour larval delta smelt mortality indicated higher concentrations than juveniles (median LC10 =  
19 9.3 µg/L; median LC50 = 80.4 µg/L), these results were complicated by differences in exposure  
20 duration and experimental conditions (particularly for factors such as temperature and conductivity  
21 that may affect copper toxicity) (Connon et al. 2011).

22 There is some evidence that larval delta smelt swimming velocity decreases as dissolved copper  
23 concentration increases, although experimental testing did not find statistical differences between  
24 test subjects and controls (Connon et al. 2011). Various delta smelt genes have been shown to have  
25 altered expression in copper-exposed larvae (Connon et al. 2011).

26 There is insufficient data to estimate the amount of copper present in soils of Alternative 1A ROAs,  
27 or the amount of copper that would be mobilized into the aquatic system and become bioavailable.  
28 Given that the overall detected levels of copper are low and that applications of copper-containing  
29 pesticides at formerly agricultural ROAs will cease, which will reduce overall copper loading to the  
30 system, effects of copper on Delta Smelt due to Alternative 1A restoration activities are expected to  
31 be minimal.

### 32 ***Ammonia***

33 Based on the analysis presented in *BDCP Effects Analysis – Appendix 5D, Contaminants, Section*  
34 *5.D.4.4 Ammonia/um (hereby incorporated by reference)*, actions from Alternative 1A are not  
35 expected to result in substantial increases in ammonia concentrations in the aquatic system that  
36 could affect covered fish species. Analysis of the ability of the Sacramento River to dilute ammonia  
37 discharges from the Sacramento WWTP indicates that resultant concentrations would be within  
38 ecologically acceptable limits under the BDCP alternatives. Further, no appreciable addition or  
39 mobilization of ammonia to the aquatic system would result from restoration activities.

### 40 ***Pyrethroids, Organophosphate Pesticides, and Organochlorine Pesticides***

41 Based on the analysis in *BDCP Effects Analysis – Appendix 5D, Contaminants, Sections 5D.4.5*  
42 *Pyrethroids, 5D.4.6 Organochlorine Pesticides, 5D.4.7 Organophosphate Pesticides (hereby*

1 *incorporated by reference*), changes in concentrations of pyrethroids, organophosphate pesticides,  
2 and organochlorine pesticides resulting from the BDCP alternatives are expected in the vicinity of  
3 agricultural land restored to marshes and floodplains. These chemicals either have a strong affinity  
4 for sediment and will settle out of the water column, or will readily degrade in an aquatic system.  
5 Thus, it is expected that increases in concentrations due to BDCP alternatives would be of relatively  
6 short duration and localized near ROAs. Specific areas of these elevated toxins have not been  
7 identified, but they can be expected in any of the ROAs. Preliminary proposal restoration will take  
8 these agricultural areas out of production, therefore eliminating the source and reducing these  
9 chemicals in the Delta system, providing a long-term ecological benefit. In addition, CM19 would  
10 provide for treatment of stormwater discharges, a major contributor of pyrethroids to the Delta.  
11 Thus BDCP may result in reduced loading of pyrethroids to the Delta.

12 Pyrethroids have been shown to be lethal as low as 1 µg/L, although there are many different  
13 chemicals in this group with varying toxicities for fish. Likewise, little is known on the effects of  
14 organophosphates on fish, but elevated concentrations of organophosphates are more likely to  
15 affect the lower trophic levels that the covered fish species prey on than the fish directly (Turner  
16 2002). As these pesticides are neurotoxins, behavioral effects are of primary concern; however,  
17 Scholz et al. (2000) points out that the effects are not well understood. Scholz et al. (2000) found  
18 that diazinon concentrations as low as 1 µg/L resulted in significant impairment of predator-alarm  
19 responses, and slightly higher concentrations of 10 µg/L caused the impairment of homing behavior  
20 in Chinook salmon. Organochlorine pesticides are neurotoxic, are likely carcinogenic, and have been  
21 implicated as endocrine disruptors because of their estrogenic nature and effects on reproductive  
22 development (Leatherbarrow et al. 2006). These pesticides are highly persistent and lipophilic, and  
23 as such, they strongly bioaccumulate (Werner et al. 2008). Because of their persistence in the  
24 environment and biomagnifications through the foodweb, the main concern with organochlorines is  
25 bioaccumulation in the higher trophic levels and implications for human consumption. However,  
26 organochlorine pesticides and degradation products can directly affect fish through toxicity to  
27 lower-level invertebrates on the food chain, and toxicity to small and early life stage fish, but there is  
28 little information specific to effects on individual species. Sublethal effects may include reproductive  
29 failure and behavioral changes. Ostrach's (2008) report indicates that largemouth bass have been  
30 experiencing reproductive failure due to organochlorine compounds in San Francisco Bay, which is  
31 likely due to concentrations accumulated through biomagnifications. Because they tend to adhere to  
32 soils and particulates, organochlorine compounds may take longer to flush out than some of the  
33 more environmentally mobile constituents discussed above (e.g., copper).

34 In the Delta, fish in higher trophic levels are particularly vulnerable to these pesticides, as the  
35 chemicals will biomagnify and bioaccumulate in their tissues. These fish include white and green  
36 sturgeon, salmonids, and lampreys. As smaller fish at lower trophic levels, smelt can be expected to  
37 have less biomagnification of these pesticides.

### 38 **Summary**

39 Methylmercury would be generated by both seasonal and tidal inundation of restoration areas,  
40 particularly in the vicinity of the Yolo Bypass, Cosumnes/Mokelumne Rivers, and Suisun Marsh.  
41 Implementation of CM12 Methylmercury Management could help to minimize increased  
42 mobilization of methylmercury at restoration areas, and its subsequent accumulation in the  
43 estuarine food web. Methylmercury concentrations in water would continue to exceed criteria with  
44 or without the BDCP habitat restoration conservation measures.

1 It is anticipated that any potential effects of methylmercury on delta smelt will be addressed  
2 through implementation of CM12. CM12 is intended to minimize methylmercury exposure  
3 associated with restoration measures for delta smelt at all life stages. Further analysis and tools may  
4 be developed to further reduce methylmercury exposure for delta smelt as the habitat restoration  
5 conservation measures are refined and analyzed in site-specific documents. The site-specific  
6 analysis is the appropriate place to assess the potential for risk of methylmercury exposure for delta  
7 smelt once site specific sampling and other information can be developed.

8 Delta smelt are expected to have lower exposure to selenium than some other covered fish species  
9 (e.g., splittail and sturgeon), because they feed primarily on planktonic, rather than benthic  
10 organisms. However, the higher contribution of San Joaquin River flow to Delta outflow in  
11 Alternative 1A relative to the NAA is expected to increase the loading and by extension possibly the  
12 bioaccumulation of selenium in the low-salinity zone food web. Impacts on Delta smelt from  
13 selenium are not expected from Alternative 1A restoration projects (CM2, CM4–CM7, and CM10),  
14 given that the Delta smelt planktonic food source does not efficiently accumulate selenium, limiting  
15 this exposure route. Therefore, the effects would not be adverse. Localized, short-term increases in  
16 copper concentrations are possible, but not presently quantifiable near ROA areas, particularly in  
17 the eastern Delta. However, Alternative 1A is not expected to result in increased toxicological effects  
18 of copper on delta smelt. In addition, the removal of agricultural areas through restoration activities  
19 would eliminate some sources of copper. It is concluded for delta smelt that BDCP restoration  
20 activities will not generate adverse effects on delta smelt of copper relative to the NAA. Similarly, no  
21 appreciable addition or mobilization of ammonia to the aquatic system would result from  
22 restoration activities.

23 The removal of agricultural areas through restoration activities would eliminate some sources of  
24 organophosphate and organochlorine pesticide contamination, potentially providing a long-term net  
25 benefit to delta smelt and their supporting food web. In addition, implementing *CM19 Urban*  
26 *Stormwater Treatment* would provide for treatment of stormwater discharges, a major contributor  
27 of pyrethroid pesticides to the Delta. Thus the BDCP may contribute to reduced loading of  
28 stormwater and agricultural sources of pesticides. Therefore, the effect of BDCP on pesticides would  
29 not be adverse to delta smelt.

30 **NEPA Effects:** Overall, the effects of contaminants associated with restoration measures would not  
31 be adverse for delta smelt with respect to selenium, copper, ammonia and pesticides. The effects of  
32 methylmercury on delta smelt are uncertain.

33 **CEQA Conclusion:** As described above, methylmercury could be generated by inundation of  
34 restoration areas, particularly in the Yolo Bypass, Cosumnes/Mokelumne Rivers, and at other ROAs  
35 closest to these source areas. However, implementation of *CM12 Methylmercury Management* would  
36 help to minimize the increased mobilization of methylmercury at restoration areas. While modeling  
37 of water operations effects showed little changes in methylmercury concentrations in the water, and  
38 methylmercury concentrations would continue to exceed criteria under Alternative 1A. However,  
39 implementation of Alternative 1A is not expected to result in substantial effects on delta smelt due  
40 to increased exposure to selenium, copper, ammonia, or organophosphate, organochlorine or  
41 pyrethroid pesticides for the reasons described above. In addition, Alternative 1A is not expected to  
42 substantially increase the potential exposure of fish because elevated bioavailability likely would be  
43 localized near ROAs and over a relatively short time period. In addition, restoration of agricultural  
44 land will result in an overall reduction in these chemicals in the Delta system. When balanced by the  
45 benefits of habitat modifications associated with restoration, the potential impact of contaminants is

1 considered less than significant. Consequently, no mitigation would be required. Overall there would  
2 be a net ecological benefit to delta smelt.

### 3 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

4 As analyzed further below, proposed *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally*  
5 *Inundated Floodplain Restoration*, *CM6 Channel Margin Habitat Enhancement*, and *CM7 Riparian*  
6 *Natural Community Restoration* are intended to increase suitable habitat for delta smelt and restore  
7 important habitat functions of the Delta. For delta smelt, the intended purpose of BDCP habitat  
8 restoration is to increase the area of suitable spawning and rearing habitats in the Delta and to  
9 improve ecological functions, including the availability of food. Delta smelt are not expected to  
10 extensively utilize low order tidal marsh channels and other very shallow habitats; however, the  
11 presence of greater quantities of these habitats is intended to enhance the prey production and  
12 water quality of the higher order marsh channels and surrounding open-water areas used more  
13 extensively by delta smelt. The full analysis of habitat restoration can be found in the *BDCP Effects*  
14 *Analysis – Appendix 5E, Habitat Restoration, hereby incorporated by reference.*

15 The following section discusses expected effects of the proposed restoration activities on delta  
16 smelt.

#### 17 **CM2 Yolo Bypass Fisheries Enhancement**

18 The enhancement elements associated with *CM2 Yolo Bypass Fisheries Enhancement* (listed in Table-  
19 11-3 and described in Section 11.3.1.3) are modifications designed to increase the frequency,  
20 duration and magnitude of seasonal floodplain inundation in the Yolo Bypass. Flow modeling results  
21 indicate that at least 3,000 acres of the Yolo Bypass are inundated for at least seven days in about  
22 four out of every five years, on average, under existing biological conditions and about seven out of  
23 every eight years, on average, under Alternative 1A (see *BDCP Effects Analysis – Appendix 5E, Habitat*  
24 *Restoration, hereby incorporated by reference*). The maximum level of inundation simulated by the  
25 model, just over 25,000 acres, is expected to occur in almost seven of every ten years under  
26 Alternative 1A. The Yolo Bypass would have a minimum of approximately 150,000 acres of  
27 inundated floodplain per decade.

28 This increased floodplain inundation may increase production of phytoplankton and other algae,  
29 particularly during the extended flooding that occurs in the spring. Yolo Bypass is a sediment  
30 depositional area (Singer et al. 2008), resulting from the settling of suspended solids, and reduced  
31 turbidity. The increased area of inundation and relatively shallow habitat would also result in an  
32 increased total irradiance available for phytoplankton growth in the water column.

33 Floodplain enhancement in the Yolo Bypass also may provide benefits to the larger estuary by  
34 exporting food resources to downstream systems, providing increased production for pelagic  
35 species such as delta smelt (Schemel et al. 2004; Ahearn et al. 2006; Lehman et al. 2008b). Ahearn et  
36 al. (2006) found that floodplains that are connected and disconnected in pulses can act as a  
37 “productivity pump” for the lower estuary by exporting food resources, especially algae, to support  
38 food webs in downstream communities (Sommer et al. 2001; Ahearn et al. 2006; Lehman et al.  
39 2008b). Other studies indicate links between carbon produced on floodplains and the downstream  
40 foodweb (Sobczak et al. 2005; Opperman et al. 2010).

41 The more frequent inundation of the Yolo Bypass under Alternative 1A is expected to translate into  
42 more frequent temporary inoculations of the Cache Slough complex with prey for adult and larval

1 delta smelt (Sommer et al. 2004). This in turn is expected to provide a notable fraction of the delta  
2 smelt population with a seasonally enhanced food source.

3 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
4 management plan would be needed to determine an operational protocol that optimizes benefits  
5 both locally and in adjacent habitats.

#### 6 ***CM4 Tidal Natural Communities Restoration***

7 As described above, *CM4 Tidal Natural Communities Restoration* is intended to increase suitable  
8 habitat for delta smelt and contribute to the overall pelagic foodweb, although the extent of this  
9 benefit is highly uncertain and will depend on site-specific characteristics and other factors. Food  
10 that is produced in the expanded tidal environments could provide benefits to delta smelt occurring  
11 in those same environments and potentially be exported to other areas of the Delta to support delta  
12 smelt. Tidal habitat restoration is projected to provide substantial increases in suitable habitat for  
13 delta smelt compared to both Existing Conditions and the NAA.

14 The potential benefit of tidal habitat restoration under CM4 for phytoplankton production was  
15 examined using the relationship between phytoplankton growth rate and depth developed by Lopez  
16 et al. (2006). The modeled rate of phytoplankton growth was calculated for the estimated average  
17 water depth of each tidal-area stratum and then multiplied by the area of the stratum, resulting in a  
18 metric termed *prod-acres* (the phytoplankton growth rate multiplied by area). Model results  
19 indicate that phytoplankton production could increase in all ROAs as a result of BDCP restoration  
20 activities, with the greatest increases in the West Delta, Cache Slough, and South Delta subregions  
21 (Table 11-1A-4). Note, however, that the model does not incorporate the effects of invasive clams  
22 which filter feed on phytoplankton and zooplankton. If restoration efforts prove successful, delta  
23 smelt could benefit from increased production of zooplankton, particularly to the extent that food  
24 resources are exported to adjacent channels and the wider estuary. However, the potential for Delta  
25 habitat to provide benefits to fish is unproven, and may not occur in proportion to the actions taken  
26 (Rose 2000).

27 Tidal habitat restoration, including the flooding of currently terrestrial areas, has the potential for  
28 some negative impacts, including those described above regarding contaminants; establishment of  
29 undesirable species that may prey upon, compete with, or alter habitat conditions for delta smelt  
30 (e.g., centrarchids, Mississippi silverside, invasive clams, *Egeria*); or production of organic matter  
31 that could contribute to low DO. The actual effects of CM4 habitat restoration are likely to vary  
32 among restoration sites, providing varying degrees of benefit to delta smelt.

1 **Table 11-1A-4. Modeled Prod-Acres under Current Conditions and by the NAA with BDCP Tidal**  
2 **Habitat Restoration**

Scenario	Prod-Acres
<b>Cache Slough</b>	
Existing	10,100
with BDCP	29,569
<b>Suisun Marsh</b>	
Existing	13,940
with BDCP	24,420
<b>West Delta</b>	
Existing	22,591
with BDCP	26,670
<b>East Delta</b>	
Existing	4,820
with BDCP	8,940
<b>South Delta</b>	
Existing	15,060
with BDCP	38,090

3

4 ***CM5 Seasonally Inundated Floodplain Restoration***

5 Under CM5, up to 10,000 acres of seasonally inundated floodplain will be restored, primarily  
6 through levee setbacks, removal of riprap, or grading of floodplain. Frequently inundated  
7 floodplains and secondary or seasonal channels and pools on the restored floodplain will create  
8 diverse, hydraulically complex habitat areas. The largest opportunity for large-scale floodplain  
9 restoration is in the South Delta along the San Joaquin River, Old River, and Middle River. CM5 is not  
10 expected to have any effects on delta smelt.

11 ***CM6 Channel Margin Enhancement***

12 There may be limited benefits for delta smelt from channel margin habitat enhancements because  
13 they are largely found downstream of the proposed enhancement areas, and are not thought to use  
14 channel margin extensively (although they may use this habitat type for spawning). There is some  
15 potential for increased food production and export, but this conservation measure is generally  
16 intended for salmonid species. In addition to the potentially limited benefits expected from channel  
17 margin enhancement efforts, channel margin habitat enhancement has the potential to increase  
18 habitat in the Plan Area for nonnative fishes that prey on or compete with delta smelt. Monitoring  
19 from bank protection projects and other future studies will inform site designs to limit the potential  
20 increase in nonnative fishes.

21 ***CM7 Riparian Natural Community Restoration***

22 Under CM7, *Riparian Natural Community Restoration*, there will be restoration of 5,000 acres of  
23 native riparian forest and scrub in association with *CM4 Tidal Natural Communities Restoration*, *CM5*  
24 *Seasonally Inundated Floodplain Restoration*, and *CM6 Channel Margin Enhancement*. While riparian  
25 restoration would reestablish fluvial geomorphologic dynamics and regenerate native plant

1 communities. CM7 is not expected to have any effects on delta smelt. Riparian restoration also will  
2 provide channel stabilization and improved water quality. Riparian zones may be natural or  
3 engineered for soil stabilization or restoration. These zones are important natural biofilters,  
4 protecting aquatic environments from excessive sedimentation, polluted surface runoff and erosion.  
5 Research shows riparian zones are instrumental in water quality improvement for both surface  
6 runoff and water flowing into streams through subsurface or groundwater flow. Particularly the  
7 attenuation of nitrate or denitrification of the nitrates from fertilizer in this buffer zone is important.  
8 Riparian zones can play a role in lowering nitrate contamination in surface runoff from agricultural  
9 fields, which runoff would otherwise damage ecosystems and human health.

#### 10 **CM10 Nontidal Marsh Restoration**

11 CM10 will result in the establishment of 400 acres of nontidal marsh in three areas: Yolo Bypass,  
12 North Delta and Cache Slough. Since these communities are upland communities they would  
13 primarily provide indirect benefits to delta smelt and other aquatic species in the main river  
14 systems (Sacramento River, Yolo Bypass) and Delta. Upland wetlands provide hydrologic and water  
15 quality functions, e.g., storing water during floods, filtering contaminants), but CM10 is not expected  
16 to have any effects on delta smelt.

#### 17 **Habitat Restoration and Climate Change**

18 Despite the improvements in habitat area and habitat functions in the Delta from floodplain, tidal,  
19 channel margin and riparian habitat restoration activities, habitat quality for delta smelt is expected  
20 to decline in the LLT primarily because of climate change (Cloern et al. 2011; Brown et al. 2013) and  
21 the associated increases in Delta water temperatures.

22 **NEPA Effects:** It is concluded that overall, the effect of restoration activities under Alternative 1A  
23 relative to NAA is expected to provide a net benefit for delta smelt, which may spend their entire  
24 lives in the Plan Area.

25 **CEQA Conclusion:** All of the impacts associated with the individual habitat restoration actions are  
26 considered beneficial because they are intended to increase suitable habitat and habitat functions.  
27 Consequently, no additional mitigation is required.

#### 28 **Other Conservation Measures (CM12–CM19 and CM21)**

##### 29 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

30 Details associated with methylmercury are provided in *BDCP Effects Analysis – Appendix 5D,*  
31 *Contaminants, Section 5D.4.4 Ammonia/um (hereby incorporated by reference),* and under Impact  
32 AQUA-8. CM12 will, where practicable, attempt to minimize conditions that promote production of  
33 methylmercury in restored areas and its subsequent introduction to the foodweb, and to covered  
34 species in particular. It describes pre-design characterization, design elements, and best  
35 management practices to attempt to minimize methylation of mercury, and requires monitoring and  
36 reporting of observed methylmercury levels.

37 **NEPA Effects:** The effects of methylmercury management on delta smelt would not be adverse.

38 **CEQA Conclusion:** Effects of *CM12 Methylmercury Management* in upstream areas and within the  
39 Delta is expected to reduce overall methylmercury levels resulting from BDCP habitat restoration

1 activities. Since it is designed to improve water quality and habitat conditions, impacts would be less  
2 than significant and, with restoration, would be beneficial. Consequently, no mitigation is required.

### 3 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

4 The following analysis is based on the more detailed analysis included in *BDCP Effects Analysis –*  
5 *Appendix 5F, Biological Stressors, Section 5F.1.1 Invasive Aquatic Vegetation, Section 5F.4 Invasive*  
6 *Aquatic Vegetation, and 5F.5.3.2.3 Nonnative Aquatic Vegetation Control (Conservation Measure 13)*  
7 *(hereby incorporated by reference).*

8 A general analysis of the effects on covered fish species has been conducted that is relevant to the  
9 effects on delta smelt. Control of invasive aquatic vegetation (IAV) in the Plan Area would occur  
10 through chemical and mechanical treatment in both areas restored under BDCP, as well as other  
11 areas throughout the Delta. CM13 includes control of IAV, especially submerged aquatic vegetation  
12 (SAV), which colonizes BDCP restoration sites to ensure that the benefits of these restoration  
13 projects are not eroded by IAV. Most IAV colonization is expected to occur in tidal wetlands. The  
14 primary concern is with *Egeria densa*, which has the ability to grow year-round in the Delta and very  
15 rapid growth rates, especially when densities are low. Therefore, it is a very effective invader of  
16 open water habitats such as would exist in newly restored shallow-water habitats. Effective control  
17 of IAV in restoration sites is likely feasible because infestations would be treated when first  
18 observed and relatively small.

19 There would also be support for SAV control efforts in the Plan Area outside restoration sites by  
20 providing additional funding for the current California Department of Boating and Waterways  
21 (DBW) water hyacinth and *Egeria densa* control programs. These programs tested a range of  
22 herbicides and mechanical control techniques, and conducted extensive toxicology and water  
23 quality testing required by the terms of its NPDES permit and under biological opinions issued by  
24 the USFWS and the NMFS. The results of post-treatment efficacy, toxicology, and water quality  
25 monitoring have been used to hone the programs to maximize the reduction in IAV while  
26 minimizing potential toxic and adverse effects.

27 Implementation of the DBW programs has been resource-limited and as a result, initially was not  
28 able to keep up with the rapid expansion of *Egeria* across the Delta. However, where applied, it has  
29 been effective at specific sites if treatment is continued and monitoring and follow-up treatment  
30 conducted, even on large areas such as Franks Tract. Enhancement of the current DBW programs is  
31 expected to provide benefits to covered fish species, including delta smelt, based on the current  
32 effectiveness of the program and the proposed expansion under the BDCP. However, these benefits  
33 are expected to be modest because of the current distribution and rate of spread of SAV in the Delta.  
34 Additional benefits could occur, given recent estimates of *Egeria* cover and the indication that the  
35 rate of spread is decreasing. For example, in 2006, DBW estimated that approximately 11,500–  
36 14,000 acres of the Delta are infested by Brazilian waterweed *Egeria* and that it is spreading at a  
37 rate of 10–20% per year, potentially doubling in acreage every 10 years (California Department of  
38 Boating and Waterways 2006). More recent estimates indicate that the total area is around 10,000  
39 acres, and the rate of spread is about 10% per year (Ustin 2008). Under *CM13 Invasive Aquatic*  
40 *Vegetation Control*, BDCP is expected to treat an average of 1,679–3,358 acres per year in tidal  
41 habitat throughout the Delta (5–10% of the acreage of tidal habitat areas within and outside  
42 restoration sites).

1 **Predation**

2 SAV provides cover for ambush predators such as largemouth bass; controlling IAV may therefore  
3 assist in curbing predation. Turbidity in the Delta is lower than it was 30–40 years ago, and  
4 decreasing turbidity in the Delta may constrain the distribution of juvenile and possibly spawning  
5 delta smelt. Although the primary reason for decreasing turbidity is depletion of the erodible  
6 sediment pool (Schoellhamer 2011), SAV contributes by trapping suspended sediment and  
7 inhibiting resuspension. Delta smelt probably avoid overly clear water to reduce their risk of  
8 predation, as well as improve their ability to feed as described below.

9 **Food Consumption**

10 While the removal of SAV could result in localized increases in turbidity, and delta smelt larvae  
11 require turbidity to initiate feeding—the larvae do not feed in water that is too clear, and delta smelt  
12 feed more effectively in turbid water conditions, such changes are not expected to result in a  
13 measurable change in food consumption of delta smelt (see *BDCP Effects Analysis – Appendix 5F,*  
14 *Biological Stressors, Section 5F.4.2.1.6 Changes in Turbidity*).

15 **Spawning and Rearing Habitat**

16 Dense patches of SAV physically obstruct access for delta smelt to habitat for spawning and rearing,  
17 although the relatively small reductions in the overall distribution of SAV in the Delta are not likely  
18 to measurably increase available delta smelt spawning and rearing habitat. The effect of IAV control  
19 would not be adverse because, although modest, it is expected to provide some benefits to delta  
20 smelt. Control of IAV, and especially SAV, is expected to enhance natural community ecosystem  
21 functions by removing ecologically dominant invasive species. Dense SAV provides suitable habitat  
22 and cover for nonnative predatory fish, and reduces turbidity, which contributes to the predation  
23 rates on delta smelt. Reduced turbidity also decreases the ability of delta smelt to feed effectively,  
24 reducing growth rates. Invasive SAV also reduces accessible spawning and rearing habitat.  
25 Therefore, the control of SAV is expected to be slightly beneficial to delta smelt.

26 **NEPA Effects:** The control of IAV under *CM13 Invasive Aquatic Vegetation Control* should provide a  
27 modest net benefit to delta smelt by decreasing predator habitat, reducing water clarity, and  
28 improving feeding conditions. Reduced water clarity is expected to reduce the effectiveness of  
29 predators to prey on delta smelt, and may contribute to successful foraging by delta smelt. In  
30 addition, controlling IAV is expected to increase the suitability of spawning and rearing habitat for  
31 delta smelt, resulting in a potential beneficial effect.

32 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to delta smelt by  
33 decreasing predator habitat and increasing turbidity. Increased turbidity is expected to reduce the  
34 effectiveness of predators to prey on delta smelt, and increases the foraging ability of delta smelt. In  
35 addition, controlling IAV is expected to increase the spawning and rearing habitat for delta smelt.  
36 Therefore, the control of IAV is expected to have a slight beneficial impact on delta smelt,  
37 consequently, no mitigation would be required.

38 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

39 As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very similar to Existing  
40 Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP export service areas  
41 (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14 Stockton Deepwater*  
42 *Ship Channel Dissolved Oxygen Levels* management would improve the upstream DO conditions in

1 the San Joaquin River basin, although few if any delta smelt would occur in the channel during this  
2 period.

3 **NEPA Effects:** No discernible effect of dissolved oxygen level management on delta smelt is expected  
4 to occur.

5 **CEQA Conclusion:** As discussed in Chapter 8, *Water Quality, CM14 Stockton Deepwater Ship Channel*  
6 *Dissolved Oxygen Levels* management would improve the upstream migration conditions in the San  
7 Joaquin River basin in the fall. Few if any delta smelt would occur in the channel during this time and  
8 therefore there would be no impact. Consequently, no mitigation would be required.

9 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

10 *CM15 Localized Reduction of Predatory Fish* is intended to reduce localized abundance of fish  
11 predators of salmonids in the Delta.

12 **NEPA Effects:** There would be no effect on delta smelt from localized reduction of predatory fish.

13 **CEQA Conclusion:** *CM15 Localized Reduction of Predatory Fish* is intended to reduce localized  
14 abundance of fish predators of salmonids in the Delta. Therefore there would be no impact on delta  
15 smelt.

16 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

17 Nonphysical barriers (NPBs) in the Delta are designed to alter juvenile salmon migration routes  
18 using sound, light, and bubbles. The potential to alter delta smelt migration is unknown, but the  
19 NPBs would not be operated for this purpose. Additionally, delta smelt juveniles have only limited  
20 swimming ability so it is unknown whether delta smelt have the escape ability to be deterred by and  
21 avoid the NPBs, especially in years with high flow rates. However, the in-water structures associated  
22 with these barriers may attract fish predators, increasing localized predation risk for delta smelt  
23 migrating past the barriers. The extent of this effect is highly uncertain.

24 **NEPA Effects:** There would be no demonstrable effect of NPBs on delta smelt.

25 **CEQA Conclusion:** Nonphysical barriers (NPBs) in the Delta are designed to alter juvenile salmon  
26 migration routes using sound, light, and bubbles. The potential to alter delta smelt migration is  
27 unknown, but the NPBs would not be operated for this purpose. Additionally, delta smelt juveniles  
28 have only limited swimming ability so it is unknown whether delta smelt have the escape ability to  
29 be deterred by and avoid the NPBs, especially in years with high flow rates. However, the in-water  
30 structures associated with these barriers may attract fish predators, increasing localized predation  
31 risk for delta smelt migrating past the barriers. The extent of this effect is highly uncertain.

32 Therefore, there would be no demonstrable effect of this conservation measure on delta smelt.  
33 Consequently, no mitigation would be required.

34 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

35 *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley steelhead, green  
36 sturgeon and white sturgeon and are expected to have positive effects on their populations. Since  
37 this conservation measure is not applied to delta smelt, it would have no direct effect on them.

38 **NEPA Effects:** The effect of illegal harvest reduction on delta smelt is not adverse.

1 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
2 Valley steelhead, green sturgeon and white sturgeon and are expected to have positive effects on  
3 their populations. Since this conservation measure is not applied to delta smelt, it would have no  
4 direct impact on them. Consequently, no mitigation would be required.

#### 5 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

6 *CM18 Conservation Hatcheries* would establish new and expand existing captive conservation  
7 propagation programs for delta and longfin smelt. Two programs would be supported. One, a  
8 conservation hatchery to house a delta smelt refugial population and to provide a source of delta  
9 smelt and longfin smelt for experimentation, supplementation or reintroduction if deemed feasible  
10 by wildlife agencies. Two, expansion of the refugial population of delta smelt and establishment of a  
11 refugial population of longfin smelt at the University of California Davis Fish Conservation and  
12 Culture Laboratory in Byron. The effect of maintaining a refugial population is potentially beneficial,  
13 as it is intended to provide a safeguard against extinction. A detailed genetics management plan will  
14 be needed, to minimize problems inherent with hatchery programs (USFWS 2000; California  
15 Hatchery Science Review Group 2012). The effect of maintaining an experimental population would  
16 be modestly beneficial for the delta smelt as it would reduce the need to capture wild fish for  
17 scientific use.

18 **NEPA Effects:** The effect of conservation hatcheries on delta smelt would not be adverse.

19 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing captive  
20 conservation propagation programs for delta smelt. Two programs include a conservation hatchery  
21 for refugial delta smelt (as well as to provide a population for experimentation) and to expand  
22 refugial populations at the Byron facility. The principal purpose of this measure is to ensure the  
23 existence of refugial captive populations thereby minimizing extinction risk. The fish used for  
24 controlled laboratory experimentation would address uncertainties about their biology which can  
25 provide important information that would contribute to more effective conservation. The impacts of  
26 establishing and maintaining both the refugial population and the experimental population would  
27 be beneficial for delta smelt because they may help to address their substantial reduction in number.  
28 Consequently, no mitigation would be required for operation of the facility. Construction would  
29 require a separate permitting process.

#### 30 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

31 Urban stormwater treatment (CM19) would reduce contaminants associated with urban areas  
32 because it provides for the treatment of stormwater discharges. As discussed in Chapter 8, *Water*  
33 *Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids, Organophosphate*  
34 *Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce urban loadings of  
35 pesticides (including pyrethroids), phosphorous, trace metals and other contaminants. These  
36 reductions would contribute to improved water quality in the Delta.

37 **NEPA Effects:** Based on the improved overall water quality conditions and reduced pesticides, the  
38 effect of urban stormwater treatment on delta smelt would be beneficial.

39 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
40 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
41 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
42 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce

1 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
2 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore,  
3 the impacts of urban stormwater treatment would be beneficial because it would have a beneficial  
4 effect both directly and through habitat modifications on delta smelt. Consequently, no mitigation  
5 would be required.

6 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
7 **(CM21)**

8 Alternative 1A has the potential to reduce entrainment related to agricultural diversions through  
9 conversion of agricultural lands into tidal habitat and the consolidation and screening of remaining  
10 intakes. Alternative 1A would restore 25,000 acres of tidal habitat in the project area in the early  
11 long-term and 65,000 acres in the late long-term. There are more than 2,600 agricultural diversions  
12 in the Plan Area (California Department of Fish and Game Passage Assessment Database 2010). It is  
13 not well known to what extent covered fish species are entrained in agricultural diversions although  
14 the available evidence indicates that it is not great (Cook and Buffaloe 1998; Nobriga et al. 2004).  
15 Information regarding the sizes and types of these diversions is limited and inconsistent.  
16 Information regarding their operation is largely nonexistent. For the purposes of this analysis, it is  
17 assumed that all of these diversions are of similar size and operate in a similar manner, recognizing  
18 that this assumption is an oversimplification. Based on a hypothetical restoration scenario, it is  
19 estimated that approximately 109 diversions would be removed by the early long-term, and  
20 approximately 236 would be removed by the late long-term. This corresponds to approximately 4.2  
21 and 12.4% of the total number of diversions.

22 Larval entrainment at Delta agricultural diversions was estimated using particle tracking modeling  
23 and modeled flow scenarios (described in *BDCP Effects Analysis – Appendix 5.B Entrainment, Section*  
24 *B.6.4.1 Agricultural Diversions-Delta Smelt hereby incorporated by reference*). A low percentage of  
25 particles representing larval delta smelt was entrained at Delta agricultural diversions, averaging  
26 3.2% for Alternative 1A and 3.1% for NAA for 60-day PTM, a relative increase of 5% from NAA.

27 Based on the analysis, there is no evidence of substantial entrainment of covered fish species at  
28 agricultural diversions in the Plan Area, but some entrainment likely is occurring. Whatever  
29 entrainment is occurring would likely be reduced by decommissioning agricultural diversions in the  
30 BDCP ROAs. PTM modeling and extrapolations to a hypothetical number of diversions to be  
31 removed from the ROAs (i.e., approximately 4–12% of diversions) gave estimates of minor change in  
32 overall loss of delta smelt larvae because of such decommissioning. This estimate is uncertain  
33 because particle tracking is not necessarily an accurate representation of smelt larval behavior in  
34 relation to agricultural intakes.

35 **NEPA Effects:** It is concluded that based on these results above, the effect of removal/relocation of  
36 nonproject diversions on delta smelt would not be adverse and may be beneficial.

37 **CEQA Conclusion:** Based on PTM model runs delta smelt entrainment by agricultural diversions  
38 would be slightly reduced under Alternative 1A. Alternative 1A also has the potential to reduce  
39 entrainment related to agricultural diversions through conversion of agricultural lands into tidal  
40 habitat ranging from 25,000 acres in the early long-term and 65,000 acres in the late long-term.  
41 Based on a hypothetical restoration scenario, it is estimated that of more than 2,600 agricultural  
42 diversions approximately 109 would be removed by the early long-term and approximately 236  
43 would be removed by the late long-term. PTM modeling predicts that larval entrainment would be  
44 increased by 1% under Alternative 1A compared to Existing Conditions. This estimate is uncertain

1 because particle tracking is not necessarily an accurate representation of smelt larval behavior in  
2 relation to agricultural intakes. However, it is concluded based on these results that the effect is less  
3 than significant and may be beneficial. Consequently, no mitigation would be required.

## 4 **Longfin Smelt**

### 5 **Construction and Maintenance of CM1**

#### 6 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

7 Longfin smelt are not expected to be present in the project construction zones during the expected  
8 in-water construction window (June 1–October 31) (see Table 11-4). Therefore, there is a very low  
9 potential risk of effects from construction activities. In addition, longfin smelt are pelagic species  
10 and are less likely to be present in the construction zones than other fish species.

#### 11 ***Temporary Increases in Turbidity***

12 Similar to delta smelt, longfin smelt are pelagic fish that inhabit naturally turbid water and use  
13 turbid water as a way of hiding from predaceous fish (Moyle 2002), and are unlikely to be adversely  
14 affected by temporary increases in turbidity. As discussed for delta smelt (see Impact AQUA-1),  
15 environmental commitments would be implemented to reduce turbidity during construction  
16 activities (see Appendix 3B, *Environmental Commitments: Environmental Training; Stormwater  
17 Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management  
18 Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel  
19 Material, and Dredged Material; and Barge Operations Plan*). Pertinent details of these plans are  
20 provided under Impact AQUA-1 for delta smelt.

#### 21 ***Accidental Spills***

22 As described in Impact AQUA-1 for delta smelt, construction-related activities may affect water  
23 quality due to accidental spills of contaminants, including the inadvertent release of construction-  
24 related chemicals or waste (e.g., oil, fuel, solvents, hydraulic fluids, paint, concrete, and other  
25 materials) to surface waters, which would result in localized water quality degradation. Depending  
26 on the type and magnitude of an accidental spill, contaminants could result in adverse effects on  
27 covered fish species through direct injury and mortality or delayed effects on growth and survival of  
28 longfin smelt. However, longfin smelt are not expected to occur in the construction areas during the  
29 expected in-water construction window (see Table 11-4). Implementing the environmental  
30 commitments described under Impact AQUA-1 for delta smelt (*Environmental Training; Stormwater  
31 Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management  
32 Plan; Spill Prevention, Containment, and Countermeasure Plan*) and specifically, the *Spill Prevention,  
33 Containment, and Countermeasure Plan* (see Appendix 3B, *Environmental Commitments*) is expected  
34 to minimize the potential for introduction of contaminants to surface waters and provide for  
35 effective containment and cleanup should accidental spills occur. Pertinent details of these plans are  
36 discussed under Impact AQUA-1 for delta smelt.

#### 37 ***Disturbance of Contaminated Sediments***

38 Impact AQUA-1 describes the potential for effects from disturbing contaminated sediments during  
39 construction, although turbidity, and in turn suspension of sediments, would be minimized by  
40 implementing environmental commitments described under Impact AQUA-1 for delta smelt and in

1 Appendix 3B, *Environmental Commitments*, (*Environmental Training; Stormwater Pollution*  
2 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
3 *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*  
4 *Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan*). Pertinent measures  
5 included in these plans are discussed under Impact AQUA-1 for delta smelt. Based on their overall  
6 distribution in the Delta, longfin smelt are not likely to occur in the construction area, and would  
7 otherwise only occur for short periods of time.

### 8 ***Underwater Noise***

9 Table 11-4 illustrates the life stages of longfin smelt present in the north, east, and south Delta  
10 during the expected in-water construction window (June 1–October 31). Construction of the barge  
11 landings in the south Delta and east Delta would be the primary locations where longfin smelt could  
12 be affected by pile driving, as longfin smelt are only expected to occur at the intake construction  
13 sites during the early portion of the in-water work window. As discussed under Impact AQUA-1 for  
14 delta smelt, Mitigation Measures AQUA-1a and AQUA-1b are available to minimize this effect.

### 15 ***Fish Stranding***

16 Fish removal activities would be associated with installation of cofferdams at the north Delta intakes  
17 (see Impact AQUA-1 for delta smelt). However, due to the limited number of longfin smelt expected  
18 to occur when the cofferdams are closed, along with the implementation environmental  
19 commitment *Fish Rescue and Salvage Plan* (Appendix 3B, *Environmental Commitments*), the impacts  
20 would be minimized (see AQUA-1 for delta smelt). Pertinent details of this plan are also discussed  
21 under Impact AQUA-1 for delta smelt.

### 22 ***In-Water Work Activities***

23 As discussed for delta smelt (see Impact AQUA-1), although longfin smelt would likely avoid the  
24 noise and activity of pile installation and placement of riprap protection, these activities have the  
25 potential to result in direct impact. However, the low numbers of this species likely to be present  
26 during the work window would limit potential effects, along with implementing the environmental  
27 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
28 *Commitments*, including *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable Tunnel*  
29 *Material, and Dredged Material; and Barge Operations Plan*.

### 30 ***Loss of Spawning, Rearing, or Migration Habitat***

31 As described in Impact AQUA-1, in-water construction would temporarily or permanently alter  
32 habitat conditions in the vicinity of the construction activities. As noted above, only a small number  
33 of juvenile longfin smelt are present during the expected in-water construction window and  
34 primarily in the south Delta and east Delta in June (see Table 11-4). Intake construction and  
35 associated channel dredging would result in a permanent loss of up to approximately 8,300 lineal  
36 feet of channel margin in low-quality rearing and migration habitat. Most spawning is believed to  
37 take place in the Sacramento River near or downstream of Rio Vista, and at or downstream of  
38 Medford Island on the San Joaquin River (Wang 1986). Therefore, fish passage and migration would  
39 not be affected by this loss of shoreline habitat. Construction of intake facilities would alter armored  
40 bank habitat, but is not substantially affect longfin smelt migration or rearing habitat.

41 As described in Impact AQUA-1, at the six barge landings, there would be in-water and over-water  
42 structures for several years each while the tunnel is constructed. The barge landings would each

1 occupy approximately 15,000 square feet of shoreline habitat within their respective delta channels.  
2 However, development and implementation of environmental commitments described under  
3 Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment*  
4 *Control Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations*  
5 *Plan*, would minimize potential effects of construction and maintenance of the barge landings on  
6 longfin smelt habitat (see Impact AQUA-1 for delta smelt).

### 7 **Predation**

8 As discussed for delta smelt under Impact AQUA-1, in-water structures, such as those that would be  
9 constructed at the barge landings have the potential to attract predatory fish that may prey on  
10 longfin smelt. Although longfin smelt are rare and an open-water species, which are generally not  
11 found in the stomach contents of predatory fish that have been sampled in the Delta (U.S. Fish and  
12 Wildlife Service 2008; Nobriga and Feyrer 2008), it is plausible that some increased predation could  
13 occur if in-water and over-water structures provide an increase in suitable predator habitat. This  
14 impact would not adversely affect longfin smelt populations because these localized effects would  
15 not have population level effects.

### 16 **Summary**

17 Potential impacts from implementation of CM1 Water Facilities and Operations on longfin smelt  
18 would be similar to those outlined above for delta smelt (see Impact AQUA-1), although the  
19 magnitude of their effects is anticipated to be lower because longfin smelt occupy habitat seaward of  
20 delta smelt (e.g., Dege and Brown 2004; Rosenfield and Baxter 2007). In-water construction  
21 activities would be scheduled to occur during the approved in-water construction window, when the  
22 fewest longfin smelt would likely be present in or near the construction areas. Implementation of  
23 environmental commitments Environmental Training; Stormwater Pollution Prevention Plan;  
24 Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,  
25 Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and  
26 Dredged Material (see Appendix 3B, Environmental Commitments and Impact AQUA-1 for delta  
27 smelt)—as well as the species' tolerance to turbidity—would minimize effects of construction  
28 activities related to turbidity, accidental spills, onsite and offsite sediment transport to surface  
29 waters, and re-suspension and redistribution of potentially contaminated sediments. As a result,  
30 these effects would not be adverse to longfin smelt.

31 The low numbers of longfin smelt that would likely be present during the in-water work windows at  
32 most construction sites east of Suisun Marsh would also minimize the potential for longfin smelt to  
33 be injured or killed as a result of in-water construction activities (including impact pile driving  
34 during the construction of the new water diversions). The implementation of the avoidance and  
35 minimization measures included in Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
36 possibly even eliminate adverse effects to longfin smelt from impact pile driving (e.g., injury or  
37 mortality). Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge*  
38 *Operations Plan* (as described in Appendix 3B and under Impact AQUA-1 for delta smelt) would also  
39 offset potential effects of construction activities on any lingering individual longfin smelt.  
40 Construction of the approach canal and Byron Tract Forebay would not affect fish-accessible  
41 waterways and therefore would not affect longfin smelt. As a result, these construction activities  
42 would not result in adverse effects on longfin smelt.

43 Localized removal of specific predator hot spots, targeted predator removal, and other focused  
44 methods to reduce predation on longfin smelt may potentially offset any increases in predator

1 habitat from the temporary construction structures (cofferdams and barge landing docks).  
2 Predation effects on longfin smelt from construction activities would not be adverse.

3 The effect of temporary and permanent rearing and migration habitat loss for longfin smelt would  
4 not be adverse due to the relatively small areas occupied by the construction and barge landing  
5 sites, and the extremely low abundance of longfin smelt anticipated to occur in the vicinity of these  
6 facilities during construction, as well as implementation of a *Barge Operations Plan* (see Appendix  
7 3B, *Environmental Commitments* and the discussion under Impact AQUA-1 for delta smelt).

8 **NEPA Effects:** Overall, the effect would not be adverse for longfin smelt.

9 **CEQA Conclusion:** The potential impact on longfin smelt from construction activities is considered  
10 less than significant due to implementation of the measures described in Appendix 3B,  
11 *Environmental Commitments*, including *Environmental Training*; *Stormwater Pollution Prevention*  
12 *Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention,*  
13 *Containment, and Countermeasure Plan*; *Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
14 *Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*. These measures would reduce  
15 the amount of turbidity from in-water construction and would guide rapid and effective response in  
16 the case of inadvertent spills of hazardous materials. In combination with the species natural  
17 tolerance to elevated turbidity levels, they would be expected to protect longfin smelt from any  
18 adverse water quality effect resulting from project construction. Construction associated with  
19 Alternative 1A will result in both temporary and permanent alteration of rearing and migratory  
20 habitat used by longfin smelt. However these impacts are not expected to be significant due to the  
21 relatively small areas occupied by the construction and barge landing sites, and the extremely low  
22 abundance of longfin smelt anticipated to occur in the vicinity of these facilities during construction.  
23 Construction would not be expected to increase predation rates relative to Existing Conditions. The  
24 direct effects of underwater construction noise on longfin smelt would be a significant impact  
25 because of the high likelihood that it would cause death to most impacted fish in the immediate  
26 vicinity of the noise. However, Mitigation Measures AQUA-1a and AQUA-1b would minimize the  
27 potential effects from underwater noise and would reduce the severity of impacts to a less-than-  
28 significant level.

29 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
30 **of Pile Driving and Other Construction-Related Underwater Noise**

31 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

32 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
33 **and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

35 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

36 ***Temporary Increases in Turbidity***

37 As discussed for construction-related effects on turbidity (Impact AQUA-1), the potential for longfin  
38 smelt to be near the intakes during the expected window of June 1 to October 31 is low. Because  
39 longfin smelt inhabit naturally turbid waters, they would not be affected by a short-term increase in  
40 turbidity during maintenance activities. Effects would be minimized by implementing the  
41 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,

1 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
2 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
3 *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
4 *Material; Fish Rescue and Salvage Plan; and Barge Operations Plan).*

#### 5 **Accidental Spills**

6 The potential effects of maintenance activities would be similar to those discussed for construction-  
7 related effects on delta smelt (see Impact AQUA-2). Effects would be minimized by implementation  
8 of environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
9 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
10 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
11 *Containment, and Countermeasure Plan).*

#### 12 **Underwater Noise**

13 As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
14 maintenance activities are not expected to reach a level that would harm juvenile or adult fishes.  
15 NMFS has found that underwater sound pressure levels less than 150 dB RMS (behavioral effects  
16 threshold) may result in temporary altered behavior of fishes indicative of stress but would not  
17 result in permanent harm or injury (National Marine Fisheries Service 2001).

#### 18 **Maintenance-Related Disturbance**

19 The potential effects of in-water maintenance activities would be similar to those discussed for  
20 construction-related effects on longfin smelt (see Impact AQUA-19). Effects would be minimized by  
21 implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
22 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
23 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
24 *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*  
25 *Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan),* and the limited use of  
26 these habitats during the expected in-water construction window.

#### 27 **Loss of Spawning, Rearing, or Migration Habitat**

28 Two maintenance activities, dredging and riprap placement, would reduce habitat values in the area  
29 around the intakes. Removal of sediment would decrease the number of macroinvertebrates around  
30 the intakes. Because longfin smelt are not benthic feeders, removal of macroinvertebrates by  
31 dredging would not directly affect their prey abundance. However, changes in the food web even at  
32 the benthic level do have the potential to affect prey that longfin smelt consume. Longfin smelt are  
33 not expected to spawn in the areas affected by maintenance activities, and migration habitat farther  
34 out in the channel would be unaffected by dredging or riprap placement. Available rearing and  
35 migration habitat of similar quantity and quality would be readily accessible to longfin smelt. Effects  
36 would be minimized by implementation of environmental commitments described under Impact  
37 AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments,* including *Erosion and*  
38 *Sediment Control Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material;* and *Barge*  
39 *Operations Plan.*

1 **Predation**

2 Maintenance activities would be unlikely to have any measurable effect on longfin smelt predation  
3 rates. These activities may include the use of barges and other watercraft that could theoretically  
4 provide cover, shelter, and perching areas for longfin smelt predators. However, the limited  
5 duration of maintenance activities and the associated noise and disturbance would be expected to  
6 dissuade predators from concentrating at sufficient density to measurably affect predation rates on  
7 longfin smelt.

8 **Summary**

9 In-water maintenance activities would be scheduled to occur during the expected in-water work  
10 window, when the least numbers of longfin smelt would likely be present in or near the  
11 maintenance areas. In addition, longfin smelt are tolerant to increases in turbidity, which might  
12 occur during maintenance activities. Such activities would include maintenance dredging at the  
13 intake sites, and installation or repair of riprap bank armoring. Implementation of the  
14 environmental commitments described in Appendix 3B, *Environmental Commitments*, would further  
15 minimize or eliminate effects on longfin smelt by limiting hazardous material spills, and by guiding  
16 the rapid and effective response in the case of inadvertent spills of hazardous materials, should they  
17 occur. These environmental commitments are *Environmental Training; Stormwater Pollution*  
18 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
19 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
20 *and Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1 for delta  
21 smelt.

22 Implementation of these environmental commitments, along with the low numbers of longfin smelt  
23 expected to occur in the maintenance areas during the expected in-water work windows and the  
24 limited frequency and duration of in-water maintenance activities, would result in a very low  
25 potential for adverse effects on longfin smelt. In addition, little or no spawning habitat occurs in the  
26 areas potentially affected by maintenance activities.

27 **NEPA Effects:** Short-term maintenance activities would not adversely affect longfin smelt.

28 **CEQA Conclusion:** Longfin smelt inhabit naturally turbid water and are not expected to be affected  
29 by temporary increases in turbidity during maintenance activities. In addition to the limited  
30 frequency and duration of in-water maintenance activities and implementation of commitments  
31 identified above and described in detail in Impact AQUA-1 and Appendix 3B, *Environmental*  
32 *Commitments*, would minimize the potential for maintenance activities to affect longfin smelt by  
33 limiting turbidity increases, and by guiding the rapid and effective response in the case of  
34 inadvertent spills of hazardous materials. These environmental commitments are *Environmental*  
35 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
36 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of*  
37 *Spoils, Reusable Tunnel Material, and Dredged Material*. Potential changes to habitat would also be  
38 limited and temporary. Therefore, the potential impact of maintenance activities is considered less  
39 than significant because it would not substantially reduce longfin smelt habitat, restrict its range, or  
40 interfere with its movement. Consequently no mitigation would be required.

**Water Operations of CM1**

**Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

***Water Exports from SWP/CVP South Delta Facilities***

Overall, entrainment of larval and adult longfin smelt at the south Delta export facilities may decrease under Alternative 1A, compared to the No Action Alternative. Entrainment for these life stages follows a familiar pattern evident in a number of the covered species: decreases in entrainment under Alternative 1A relative to NAA in higher-flow years coupled with modest changes (increases or decreases) in lower-flow years.

Entrainment at the SWP and CVP facilities is not believed to be an important stressor influencing the survival of longfin smelt larvae. If entrainment were to be a problem for longfin smelt, its effect would be seen in dry years when recruitment is expected to be lower relative to wet years (Sommer et al. 1997; DFW 2009 ; Grimaldo et al. 2009). Consequently, the population-level impact of this stressor on longfin smelt larvae is believed to be low. Entrainment loss of longfin smelt larvae to the south Delta facilities was simulated using a particle tracking model, using both wetter and drier starting distributions (detailed in *BDCP Effects Analysis – Appendix 5B Entrainment, Section 5B.6.1.6.1 hereby incorporated by reference*). Average entrainment under Alternative 1A with the wetter starting distribution was 1.0% compared to 1.6% for NAA, a 40% relative reduction (Table 11-1A-5), Under the drier starting distribution, average entrainment was 1.2% under Alternative 1A compared to 2.2% for NAA, a 43% decrease in relative terms. Based on the limited change in entrainment under Alternative 1A, water exports from SWP/CVP south Delta facilities are not expected to measurably change the dry year entrainment risk for longfin smelt larvae.

**Table 11-1A-5. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 1A and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A1A_LLТ	A1A_LLТ vs. EXISTING CONDITIONS	A1A_LLТ vs. NAA
Wetter	1.9	1.6	1.0	-0.90 (-48%)	-0.65 (-40%)
Drier	2.5	2.2	1.2	-1.27 (-51%)	-0.93 (-43%)

Longfin smelt entrainment at the south Delta facilities was calculated by normalizing salvage data against fall midwater trawl abundance indices. For juvenile longfin smelt, estimated entrainment loss in March -June varied considerably among water years, with highest loss (hundreds of thousands of fish) occurring in dry and critical years, and several orders of magnitude lower in other water year types (refer to *BDCP Effects Analysis - Appendix 5.B, Section 5B.6.1.6.2*). Overall entrainment loss averaged across all water years would be similar to NAA, in large part due to substantial reductions in entrainment in wet water years (Table 11-1A-6). In low-flow (dry and critical) years, when most entrainment of juvenile longfin smelt would occur, entrainment loss under Alternative 1A would be 14% more in dry years, but 5% less in critical years compared to baseline conditions. Entrainment would be 46% more in below-normal water years under Alternative 1A.

1 **Table 11-1A-6. Longfin Smelt Entrainment Index at the SWP and CVP Salvage Facilities and**  
2 **Differences (Absolute and Percentage) between Model Scenarios**

Life Stage	Water Year Types	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
Juvenile (March–June)	Wet	-25,499 (-40%)	-30,942 (-45%)
	Above Normal	1,891 (42%)	1,602 (33%)
	Below Normal	1,713 (56%)	1,505 (46%)
	Dry	142,066 (27%)	83,759 (14%)
	Critical	-99,713 (-18%)	-25,842 (-5%)
	All Years	20,530 (8%)	-4,481 (-2%)
Adult (December–March)	Wet	-98 (-76%)	-101 (-77%)
	Above Normal	-353 (-54%)	-394 (-57%)
	Below Normal	-516 (-27%)	-438 (-24%)
	Dry	-342 (-29%)	-277 (-24%)
	Critical	-7,158 (-29%)	-5,025 (-23%)
	All Years	-2,250 (-62%)	-2,214 (-62%)

Shading indicates >5% increase in entrainment index.

3

4 A substantial proportion of the adult longfin smelt population is expected to be in the Delta during  
5 drier years. In wetter years, adult longfin smelt are expected to be distributed near the confluence of  
6 the Sacramento-San Joaquin River or in Suisun Bay or areas to the west (e.g., the Napa River).  
7 Estimated entrainment loss of adult longfin smelt from December to March under Alternative 1A  
8 would be 62% lower averaged across all water years, and 23-24% lower in dry and critical water  
9 years, compared to NAA (Table 11-1A-6).

10 The reductions in entrainment projected for adult longfin smelt under Alternative 1A would partially  
11 offset the increases in juvenile entrainment in dry water years. If population size increases in the  
12 future, take at the south Delta facilities could increase, although the amount of take (as a proportion  
13 of the entire population) averaged across water years is expected to be lower under Alternative 1A  
14 relative to the NAA.

15 **Water Exports from SWP/CVP North Delta Intake Facilities**

16 Entrainment of longfin smelt larvae at the north Delta intakes occurs only under the action  
17 alternatives, including Alternative 1A, because there are no north Delta intakes operational under  
18 NAA. However, impingement and entrainment of longfin smelt would be very limited because it  
19 would be an exceptionally rare occurrence for longfin smelt to be this far upstream. In addition, the  
20 screened intakes are designed to meet CDFW criteria for smelt protection.

21 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

22 Larval entrainment to NBA was assessed by particle tracking modeling, using starting distributions  
23 emulating longfin smelt distribution in wetter years (i.e. greater outflow, smelt spawn further west)  
24 and drier years (i.e., longfin smelt spawning occurs further east and deeper into the Delta). Particle  
25 entrainment at the NBA was low for both starting distributions (wetter and drier), averaging 0.13-  
26 0.16% under Alternative 1A, which was 0.05-0.06% less than NAA, or 54-60% increase in relative

1 terms (Table 11-1A-7). Overall, it is expected that entrainment of larval longfin smelt to the NBA  
2 would be very low.

3 **Table 11-1A-7. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt**  
4 **Entrained by the North Bay Aqueduct under Alternative 1A and Baseline Scenarios**

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A1A_LLТ	A1A_LLТ vs. EXISTING CONDITIONS	A1A_LLТ vs. NAA
Wetter	0.20	0.08	0.13	-0.07 (-36.7%)	0.05 (60.3%)
Drier	0.25	0.11	0.16	-0.08 (-33.5%)	0.06 (54.4%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

5  
6 In contrast to delta smelt, it was estimated that entrainment of longfin smelt larvae would increase  
7 at the Barker Slough Pumping Plant under Alternative 1A relative to NAA as often as it was  
8 predicted to decrease; however, the percentage of entrained particles was very low (as described  
9 above) and is anticipated to become even lower with implementation of a dual conveyance.

10 If unforeseen changes in distributions or other factors occur as a result of project operations that  
11 would increase proportional loss of longfin smelt to entrainment, monitoring and the BDCP-  
12 proposed Real-Time Response Team would implement measures to avoid or minimize any potential  
13 threats to the species that might occur. Based on current scientific understanding, this would not be  
14 necessary.

15 **Summary**

16 Alternative 1A is expected to decrease the entrainment of adult and larval longfin smelt and increase  
17 the entrainment of juvenile longfin smelt at the south Delta facilities (see Tables 11-1A-5 and 11-1A-  
18 7). If the longfin smelt population recovers, take at the south Delta facilities could increase, even  
19 though the proportional loss may be lower under Alternative 1A than the NAA. It is concluded that  
20 these changes in longfin smelt entrainment would be adverse under Alternative 1A.

21 It is concluded that north Delta entrainment and impingement will be higher in Alternative 1A than  
22 the NAA simply because there are no north Delta diversions in the NAA scenario; however,  
23 impingement and entrainment of adult and larval longfin smelt, respectively, will not be adverse  
24 because it is anticipated that very few individuals will use this river reach for migrating and  
25 spawning. If unforeseen changes in distributions or other factors occur as a result of project  
26 operations that would increase the proportional loss of longfin smelt to entrainment, monitoring  
27 and the BDCP-proposed Real-Time Response Team would implement measures to avoid or  
28 minimize any potential threats to the species that might occur. Based on the current analysis, this  
29 would not be necessary.

30 **NEPA Effects:** The overall effect of the Alternative 1A operations scenario would not be adverse to  
31 longfin smelt.

32 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
33 SWP/CVP south Delta facilities under Alternative 1A would not result in reduced entrainment of  
34 adult and larval longfin smelt across all water year types (Table 11-1A-6). Juvenile entrainment  
35 under Alternative 1A would be 18% lower in critical years, but would increase in dry (27% more),

1 below-normal (56%) and above-normal (42%) water year types compared to Existing Conditions.  
2 Operational activities associated with implementing a dual conveyance for the SWP NBA would not  
3 result in an increase in entrainment of longfin smelt. The overall impact of water operations under  
4 Alternative 1A on entrainment at SWP/CVP facilities is considered significant because of increased  
5 dry-year juvenile entrainment of longfin smelt. Management by the Real-Time Response Team  
6 would help reduce the extent of entrainment losses under Alternative 1A, especially in drier years,  
7 but not necessarily to a less-than-significant level.

## 8 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing** 9 **Habitat for Longfin Smelt**

10 Adult longfin smelt inhabit primarily brackish water and marine areas in San Pablo and San  
11 Francisco Bays and nearshore coastal marine waters. Prespawning adult longfin smelt use the Delta  
12 for staging and spawning. The planktonic larvae are transported downstream after hatching; within  
13 the Plan Area, the early juvenile life stages rear in the low-salinity areas of the West Delta and  
14 Suisun Bay subregions. Juvenile and adult longfin smelt occupying the Plan Area during fall through  
15 spring migrate westward into San Francisco Bay during the summer.

16 Longfin smelt spawn in the late winter and early spring months when water temperatures in the  
17 lower rivers and Delta are seasonally cool. Longfin smelt spawn adhesive eggs that are thought to be  
18 deposited on sand and gravel and possibly other hard substrates. Spawning occurs in the lower  
19 reaches of the Sacramento River in the vicinity of Cache Slough and Rio Vista, although some  
20 spawning occurs in the lower San Joaquin River based on presence of early larval and adult longfin  
21 smelt in CDFW larval trawl samples (California Department of Fish and Game 2009b). Spawning also  
22 occurs in Suisun Marsh and the Napa River.

23 Immediately after hatching from the incubating eggs, longfin smelt larvae are planktonic and drift  
24 passively with water flows; older larvae use a variety of behaviors to help retain themselves in  
25 favorable habitats (Bennett et al. 2002). Larvae are typically present in the Delta during the late  
26 winter and early spring months. Juvenile longfin smelt rear in the spring (approximately March to  
27 June) in the Suisun Bay and the West Delta subregions before migrating downstream of the Plan  
28 Area into San Pablo and San Francisco Bays and nearshore coastal marine waters, where they  
29 continue to rear for a year or more. Larval and early juvenile longfin smelt could be affected by  
30 covered activities when they are present in the Plan Area during the winter and spring months.

31 Adult longfin smelt are present in the Delta portions of the Plan Area typically from approximately  
32 November through March. Based on historical patterns, a substantial proportion of the adult longfin  
33 smelt population is expected to be in the Delta during these months in drier years. In wetter years,  
34 adult longfin smelt are expected to be distributed near the confluence of the Sacramento and San  
35 Joaquin Rivers in the lower West Delta subregion, in the Suisun Bay subregion, or in areas to the  
36 west of the Plan Area (e.g., the Napa River). During the fall, prespawning adult longfin smelt migrate  
37 upstream into the Suisun Bay subregion, the lower Sacramento River portion of the West Delta  
38 subregion, and other parts of the Delta prior to spawning. The indices of abundance of longfin smelt  
39 based on the fall midwater trawl (FMWT), bay otter trawl, and bay midwater trawl have been  
40 correlated to outflow (expressed as the location of X2) in the preceding winter and spring months,  
41 when spawning and rearing is occurring (January through June) (Kimmerer 2002a; Kimmerer et al.  
42 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al. 2010). Based on Kimmerer  
43 et al. 2009, reduced outflow in January through June under Alternative 1A compared to the NAA has

1 the potential to reduce longfin smelt abundance. Other components of Alternative 1A have the  
2 potential to increase recruitment per unit of flow.

3 **NEPA Effects:** Modeling results based on Kimmerer et al. 2009 predict longfin smelt Fall Midwater  
4 Trawl and Bay Otter Trawl indices would decrease 8–10% relative to NAA, for all years combined,  
5 based on changes in winter-spring flow alone (Table 11-1A-8). The greatest decreases in longfin  
6 smelt indices based on Kimmerer et al. 2009 are predicted to occur in above normal, below normal  
7 and dry water year types (10–18% reduction compared to NAA), when changes in winter-spring  
8 outflow are greatest under Alternative 1A compared to the NAA. This analysis does not take into  
9 account any potential changes in spawning or rearing conditions related to non-operational  
10 components of Alternative 1A, including habitat restoration.

11 **Table 11-1A-8. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in**  
12 **the Fall Midwater Trawl or Bay Otter Trawl**

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
All	-1,501 (-31%)	-304 (-8%)	-4,757 (-36%)	-933 (-10%)
Wet	-6,055 (-33%)	-128 (-1%)	-24,993 (-38%)	-508 (-1%)
Above Normal	-2,825 (-36%)	-857 (-15%)	-9,794 (-42%)	-2,877 (-17%)
Below Normal	-1,378 (-37%)	-431 (-15%)	-4,124 (-42%)	-1,248 (-18%)
Dry	-557 (-29%)	-154 (-10%)	-1,470 (-34%)	-395 (-12%)
Critical	-144 (-16%)	-47 (-6%)	-331 (-19%)	-106 (-7%)

Shading indicates 10% or greater decrease in relative abundance under Alt1A.

Note: Based on the X2-Relative Abundance Regressions of Kimmerer et al. (2009).

13  
14 Larval longfin smelt may benefit from habitat restoration such as CM2 (Yolo Bypass Fisheries  
15 Enhancement) for smelt present in Cache Slough region, or CM4 (Tidal Natural Communities  
16 Restoration) for smelt in the west Delta and Suisun Bay. This restored habitat is intended to provide  
17 additional food production and export to rearing areas.

18 **CEQA Conclusion:** Under Alternative 1A, average Delta outflow compared to Existing Conditions  
19 would be slightly increased in winter (6% greater in January and February), similar in March, and  
20 decreased in spring (14% lower in April, 26% lower in May, 16% lower in June). Average relative  
21 abundance of longfin smelt is decreased 31–36% compared to Existing Conditions, based on  
22 Kimmerer et al. 2009 (Table 11-1A-7).

23 It is worth noting that this CEQA analysis predicts a greater decrease in juvenile relative abundance  
24 than estimated under the NEPA analysis set forth above. This interpretation of the biological  
25 modeling is likely attributable to different modeling assumptions for four factors: sea level rise,  
26 climate change, future water demands, and implementation of the alternative. As discussed above  
27 (Section 11.3.3), because of differences between the CEQA and NEPA baselines, it is sometimes  
28 possible for CEQA and NEPA significance conclusions to vary between one another under the same  
29 impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was  
30 prepared, which does not partition the effect of implementation of the alternative from the effects of  
31 sea level rise, climate change and future water demands using the model simulation results. Both the  
32 action alternative and the NEPA baseline (NAA) models anticipated future conditions that would

1 occur in 2060 (LLT implementation period), including the projected effects of climate change  
2 (precipitation patterns), sea level rise and future water demands, as well as implementation of  
3 required actions under the BiOps. Because the action alternative modeling does not partition the  
4 effects of implementation of the alternative from the effects of sea level rise, climate change and  
5 future water demands, the comparison to Existing Conditions may not offer a clear understanding of  
6 the impact of the alternative on the environment. This suggests that the NEPA analysis, which  
7 compares results between the alternative and NAA, is a better approach because it isolates the effect  
8 of the alternative from those of sea level rise, climate change, and future water demands.

9 When compared to NAA and informed by the NEPA analysis above, longfin smelt abundance, based  
10 on Kimmerer et al. (2009) decreased 8% to 10% on average compared to NAA, with a 17% to 18%  
11 reduction in above normal and below normal water year types (Table 11-1A-7). These results  
12 represent the increment of change attributable to the alternative, and address the limitations of the  
13 comparison to the CEQA baseline (Existing Conditions).

14 As described above, other measures could reduce this potential impact. This includes habitat  
15 restoration (CM4), which may improve the quality of spawning and rearing habitat for longfin smelt  
16 by increasing suitable habitat area and food production in the Delta. The Adaptive Management and  
17 Monitoring Program could adjust spring operations as determined necessary through the adaptive  
18 management process. However, given the uncertainty of the outcome related to habitat restoration,  
19 the uncertainty regarding the actual mechanism for the outflow-abundance relationship included in  
20 Kimmerer et al. 2009, and the modeled change in winter-spring outflow, the impact may be  
21 significant, and mitigation would be required. Implementation of Mitigation Measures AQUA-22a  
22 through 22c, habitat restoration and adaptive management would reduce this impact to less than  
23 significant.

24 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**  
25 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**  
26 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

27 Upon the commencement of operations of CM1 and continuing through the life of the permit, the  
28 BDCP proponents will monitor effects on spawning and rearing habitat in order to determine  
29 how to manage winter-spring outflow to minimize effects on longfin smelt, in light of the overall  
30 effects of Alternative 1A. This mitigation measure requires a series of actions to accomplish  
31 these purposes, consistent with the operational framework for Alternative 1A.

32 The development and implementation of any mitigation actions shall be focused on those  
33 incremental effects attributable to implementation of Alternative 1A operations only.  
34 Development of mitigation actions for the incremental effect on rearing habitat attributable to  
35 climate change/sea level rise are not required because these changed conditions would occur  
36 with or without implementation of Alternative 1A.

37 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**  
38 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

39 Following commencement of initial operations of CM1 and continuing through the life of the  
40 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
41 modified operations could reduce impacts to rearing habitat under Alternative 1A. The  
42 additional evaluations would specifically consider March through May Delta outflow monitoring  
43 and the relationship between Delta outflow and longfin smelt abundance (Kimmerer et al.

2009). Despite this identified relationship, the specific timing and amount of outflow needed to conserve longfin smelt, especially in light of potential increases in food resources in the Plan Area, and other benefits to spawning and rearing habitat is unknown. The analysis required under this measure may be conducted as a part of the Adaptive Management and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6) and used to adjust spring operations as determined necessary.

**Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

In order to determine the feasibility of reducing the effects of CM1 operations on longfin smelt habitat, the BDCP proponents will consult with USFWS and CDFW to identify and implement any feasible operational means to minimize effects on rearing habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-22a.

**Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

*The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on rearing habitat for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.*

**Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

*The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on migration conditions for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.*

**Restoration Measures (CM2, CM4–CM7, and CM10)**

**Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

***Temporary Increases in Turbidity***

Restoration activities such as riprap removal, shoreline excavation and re-contouring, and planting riparian vegetation have the potential to result in temporary increases in turbidity conditions in adjacent waterways. However, longfin smelt inhabit naturally turbid water and forage more effectively in turbid water. Therefore, longfin smelt are unlikely to be affected by temporary increases in turbidity during restoration construction. Furthermore, implementing the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Fish Rescue and Salvage Plan; and Barge Operations Plan)* would minimize the potential for turbidity to affect longfin smelt.

***Increased Exposure to Methylmercury***

Methylmercury would be generated by both seasonal and tidal inundation of restoration areas, particularly in the vicinity of the Yolo Bypass, Cosumnes/Mokelumne Rivers, and Suisun Marsh (see discussion for delta smelt under Impact AQUA-8). However, the environmental commitments described above to reduce turbidity will also minimize suspension of potentially contaminated

1 sediments. Implementation of CM12 Methylmercury Management is also expected to help minimize  
2 increased mobilization of methylmercury at restoration areas, and its subsequent accumulation in  
3 the estuarine food web. In addition, some habitat restorations, including constructing managed  
4 wetlands and tidal marsh habitat, would likely reduce the methylation of mercury. As described  
5 above for delta smelt, Alternative 1A restoration actions (CM2, CM4–CM7, and CM10) are likely to  
6 result in some increased production, mobilization, and bioavailability of methylmercury in the  
7 aquatic system. Modeling of Alternative 1A water operations (CM1) effects showed little changes in  
8 methylmercury concentrations in the water. To address the issue of methylmercury production at  
9 restoration areas, management measures will be implemented through CM12. As such, it is  
10 concluded that the mobilization of methylmercury, due to BDCP restoration actions would not be  
11 adverse for longfin smelt, relative to the NAA. Given current information however, it is not possible  
12 to determine the concentrations of methylmercury that would become available to longfin smelt as a  
13 result of these restoration activities.

#### 14 **Accidental Spills**

15 Restoration activities such as levee construction or breaching, site grading, and placement of riprap  
16 involve the use of heavy equipment in proximity to aquatic environments, presenting the potential  
17 for spills of fuel, fluids, and lubricants that could potentially harm aquatic species and their habitats.  
18 Adverse effects from accidental spills will be avoided through implementation of appropriate impact  
19 avoidance and minimization measures (*Environmental Training; Stormwater Pollution Prevention*  
20 *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
21 *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
22 *Material; and Barge Operations Plan; see Appendix 3B, Environmental Commitments and Impact*  
23 *AQUA-1). Specifically, the Spill Prevention, Containment, and Countermeasure Plan will be*  
24 *implemented to minimize the risk of spills occurring and to provide for rapid and effective response*  
25 *to contain any accidental spills. Therefore adverse effects from accidental spills would be unlikely to*  
26 *occur and if they did occur the effects would be short term. See discussion of sources and*  
27 *minimization measures under Impact AQUA-1).*

#### 28 **Disturbance of Contaminated Sediments**

29 Habitat restoration activities may result in the disturbance of contaminated sediments in and  
30 around aquatic habitats, with the potential for increased bioavailability, and potential effects on  
31 longfin smelt (see details in *BDCP Effects Analysis – Appendix 5.D, Contaminants, hereby incorporated*  
32 *by reference*). Runoff and resuspension of contaminated sediments could cause short-term, localized  
33 increases in the concentrations of contaminants in and near restoration sites (see discussion for  
34 delta smelt under Impact AQUA-8). The potential impacts of toxics on longfin smelt would be  
35 minimized to the extent possible by timing restoration activities so that vulnerable early life stages  
36 are not present, and implementation of environmental commitments (see Appendix 3B,  
37 *Environmental Commitments: Environmental Training; Stormwater Pollution Prevention Plan; Erosion*  
38 *and Sediment Control Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and*  
39 *Barge Operations Plan*). Pertinent details of these plans are provided under Impact AQUA-1 for delta  
40 smelt.

41 As with delta smelt, longfin smelt are expected to have lower exposure to selenium than some other  
42 covered fish species (e.g., splittail and sturgeon), because they feed primarily on planktonic, rather  
43 than benthic organisms. However, the higher contribution of San Joaquin River flow to Delta outflow  
44 in Alternative 1A relative to the NAA is expected to increase the loading and by extension possibly

1 the bioaccumulation of selenium in the low-salinity zone food web. Similar to delta smelt, longfin  
2 smelt are expected to have low exposure to selenium as they are feeding on pelagic organisms that  
3 are able to excrete most of the selenium they consume (Stewart et al. 2004). Therefore, it is  
4 concluded that Alternative 1A restoration activities would not have an adverse effects on longfin  
5 smelt from selenium exposure relative to the NAA.

6 Localized, short-term increases in copper concentrations are also possible, although the removal of  
7 agricultural areas through restoration activities would eliminate some sources of copper and  
8 pesticides. Implementing *CM19 Urban Stormwater Treatment* would also reduce the discharge of  
9 pyrethroid pesticides to the Delta. Therefore, it is concluded that Alternative 1A restoration  
10 activities will not have adverse effects on longfin smelt from copper or pesticide exposure, relative  
11 to the NAA. Similarly, no appreciable addition or mobilization of ammonia to the aquatic system  
12 would result from restoration activities.

### 13 ***In-Water Work Activities***

14 Restoration activities such as equipment mobilization, development of staging areas, and dry levee  
15 preparation could temporarily produce noise and physical disturbance levels that could affect  
16 nearby fishes. However, such activities are not expected to elevate underwater noise above the  
17 threshold sound pressure levels established for fish (see discussion for delta smelt under Impact  
18 AQUA-1). In addition, few longfin smelt are expected to occur in the areas where restoration  
19 activities would directly affect aquatic habitat, as these would occur during the expected in-water  
20 work windows when species use is expected to be minimal. Potential effects of in-water activity  
21 would be minimized by implementation of the environmental commitments described under Impact  
22 AQUA-1 and in Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment Control*  
23 *Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*.  
24 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt. Any effects  
25 would be of limited duration and short term.

### 26 ***Predation***

27 Restoration activities would be unlikely to have any measurable effect on longfin smelt predation  
28 rates. Much of the restoration would occur on dry land (e.g., recontouring, removing levees) which  
29 would have no in-water effects including on predators. The limited duration of these activities and  
30 the associated noise and disturbance would be expected to dissuade predators from concentrating  
31 at sufficient density to measurably affect predation rates on longfin smelt.

### 32 ***Summary***

33 In-water and shoreline restoration activities may result in short-term adverse effects on longfin  
34 smelt through direct disturbance, short-term water quality impacts, and through increased exposure  
35 to contaminants associated with the incidental disturbance of contaminated soils and sediments.  
36 These effects would be minimized by limiting restoration activities to the expected in-water  
37 construction window, when the least numbers of longfin smelt would likely be present in or near the  
38 restoration sites. Longfin smelt are also tolerant to increases in turbidity, reducing the potential for  
39 effects from turbidity. Implementation of the environmental commitments described in  
40 Appendix 3B, *Environmental Commitments*, would minimize or eliminate effects on longfin smelt by  
41 reducing the amount of turbidity and guiding the rapid and effective response in case of inadvertent  
42 spills of hazardous materials. These environmental commitments are *Environmental Training*;  
43 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*

1 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
2 *Reusable Tunnel Material, and Dredged Material.* Pertinent details of these plans are provided under  
3 Impact AQUA-1 for delta smelt. As a result, the effects of short-term restoration construction  
4 activities are not adverse to longfin smelt.

5 The potential long-term effects of restoration on the bioavailability of contaminants is expected to  
6 be localized, sporadic, and of low magnitude. In addition, *CM12 Methylmercury Management*  
7 provides for site-specific assessment of restoration areas, integration of design measures to  
8 minimize methylmercury production, and site monitoring and reporting. With implementation of  
9 *CM12 Methylmercury Management*, effects of methylmercury mobilization on covered fish at the  
10 tidal wetland restoration sites are expected to be minimized.

11 **NEPA Effects:** Overall, the effects of habitat restoration are expected to be beneficial to longfin smelt  
12 by providing additional or improved habitat, and other minor effects would be more than offset by  
13 the collective benefits of broad-scale habitat restoration.

14 **CEQA Conclusion:** Longfin smelt inhabit naturally turbid water and are not expected to be affected  
15 by temporary increases in turbidity during restoration activities. In addition to in-water work  
16 window restrictions, the limited frequency, duration, and spatial extent of restoration activities  
17 would minimize potential habitat or movement effects on longfin smelt. The implementation of  
18 *CM12 Methylmercury Management* would also reduce the potential for effects. Implementation of  
19 the environmental commitments described under Impact AQUA-1 for delta smelt and in detail in  
20 Appendix 3B, *Environmental Commitments (see Environmental Training; Stormwater Pollution*  
21 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
22 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
23 *and Dredged Material)* would also reduce the frequency, duration and spatial extent of any impacts.  
24 Therefore, the potential impact from restoration activities would be less than significant to longfin  
25 smelt because it would not substantially reduce habitat, restrict its range or interfere with its  
26 movement. Additionally, there would be beneficial long-term net benefits of habitat restoration.  
27 Consequently, no mitigation is required.

#### 28 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin** 29 **Smelt**

30 Effects of implementing the habitat restoration conservation measures (CM2, CM4–CM7, and CM10)  
31 on longfin smelt will depend on the life stage present in the area of elevated toxins and the duration  
32 of exposure. As previously mentioned, a complete analysis can be found in the *BDCP Effects Analysis*  
33 *– Appendix 5D, Contaminants (hereby incorporated by reference)*. Potential impacts on longfin smelt  
34 from effects of methylmercury, selenium, copper, ammonia, and pesticides associated with habitat  
35 restoration activities would be similar to those discussed for delta smelt (see Impact AQUA-10 as  
36 well as Impact AQUA-8), and may be somewhat less because longfin smelt do not utilize shallow  
37 habitats as much as delta smelt.

38 The large numbers of factors that influence the production of methylmercury in freshwater tidal  
39 habitat make it challenging to predict methylmercury conditions, covered species exposures or  
40 bioaccumulation. The limited data available from past restoration actions indicate that  
41 methylmercury production in wetlands and resulting bioaccumulation is highly variable. It is  
42 reasonable to expect that some increases in methylmercury are possible on a local or regional scale.  
43 The Delta is currently impaired for methylmercury and a TMDL from the Central Valley Regional  
44 Water Quality Control Board is guiding loading reduction for both point and non-point sources to

1 insure that the aquatic life associated beneficial uses are protected (Central Valley Regional Water  
2 Quality Control Board 2011a and 2011b). The initial phase of the 2010 TMDL is underway and  
3 includes seven years of research on the management of methylmercury associated with Delta  
4 wetlands. Longfin smelt's food and habitat preferences should represent a reduced risk of  
5 methylmercury exposure compared to other estuarine fishes.

6 It is anticipated that any potential effects of methylmercury on longfin smelt will be addressed  
7 through implementation of CM12. CM12 is intended to minimize methylmercury exposure  
8 associated with restoration measures for longfin smelt at all life stages. Further analysis and tools  
9 may be developed to further reduce methylmercury exposure for longfin smelt as the habitat  
10 restoration conservation measures are refined and analyzed in site-specific documents. The site-  
11 specific analysis is the appropriate place to assess the potential for risk of methylmercury exposure  
12 for longfin smelt once site specific sampling and other information can be developed.

13 **NEPA Effects:** The potential contaminants associated with habitat restoration activities are not  
14 expected to adversely affect longfin smelt with respect to selenium, copper, ammonia and pesticides.  
15 The effects of mercury on longfin smelt are uncertain. In addition, the benefits associated with  
16 habitat restoration are expected to result in an overall benefit to the longfin smelt.

17 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
18 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
19 However, any such releases would be short-term and localized, and would be unlikely to result in  
20 measurable increases in the bioaccumulation in longfin smelt. In addition, implementation of *CM12*  
21 *Methylmercury Management* would help to minimize the increased mobilization of methylmercury  
22 at restoration areas. Therefore, the potential impact of contaminants is considered less than  
23 significant because it would not substantially effect longfin smelt either directly or through habitat  
24 modifications and, with restoration, would be beneficial in the long-term. Consequently, no  
25 mitigation would be required.

### 26 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

27 The potential effects of restored habitat conditions on longfin smelt would be similar to those  
28 discussed for delta smelt (see the discussion under Impact AQUA-9).

### 29 **CM2 Yolo Bypass Fisheries Enhancement**

30 Similar to the discussion under Impact AQUA-9 for delta smelt, the primary benefit of Yolo Bypass  
31 fisheries enhancement would be increased food productivity and export to portions of the system  
32 used by longfin smelt.

### 33 **CM4 Tidal Natural Communities Restoration**

34 A small proportion of late-stage longfin smelt larvae may briefly occur in shallow tidal  
35 environments, and could experience direct benefits from habitat expansion and food production in  
36 the ROAs (see Impact AQUA-9), and supporting improved longfin smelt growth and survival rates.  
37 However, restored areas would be vulnerable to colonization by non-native species such as the  
38 overbite clam, which competes with native species for food. Even if desirable functions and  
39 processes become established, which can only be determined by long-term monitoring, linkages that  
40 result in benefits to fish are poorly understood and uncertain to occur (Rose 2000).

1 Although tidal habitat restoration could benefit longfin smelt, habitat conditions are likely to  
2 decrease for larval and juvenile longfin smelt over time, because of temperature effects associated  
3 with climate change during the late spring. It is anticipated that the overall effect of *CM4 Tidal*  
4 *Natural Communities Restoration* would be similar to that for delta smelt and therefore may be  
5 considered adverse, not adverse, or beneficial depending upon (1) the extent to which the actions  
6 reestablish lost or impaired habitat functions and processes and (2) the extent to which they are  
7 actually utilized by longfin smelt and remain beneficial by increasing habitat quantity, thereby  
8 providing a potential mechanism to at least partially offset the future effects of climate change (see  
9 Impact AQUA-9).

10 Longfin smelt spend less time in the Plan Area than delta smelt, which may result in less severe  
11 effects from a potential future decline in habitat quality. Because only a small proportion of the  
12 juvenile longfin smelt population that would be affected by these changes and the importance of  
13 food and habitat availability to the them, combined with the potential temporal compression in the  
14 availability of rearing habitat based on increased temperatures resulting from climate change,  
15 indicate that habitat restoration may potentially result in a small net benefit to juvenile longfin  
16 smelt.

#### 17 ***CM5 Seasonally Inundated Floodplain Restoration***

18 For discussion of the potential effects on longfin smelt, see the discussion under Impact AQUA-9 for  
19 delta smelt. Providing river–floodplain connectivity could increase production of lower trophic  
20 levels at relatively rapid time scales, with some food web organisms responding within days at high  
21 densities. Longfin smelt occur in low numbers and for a brief time in the south Delta so direct  
22 benefits for them would be limited. However, the potential export of nutrients to other areas could  
23 also benefit longfin smelt and other covered fish species although reverse flows in the south Delta  
24 reduce downstream export. Also, if longfin smelt were attracted to the south Delta they would be at  
25 increased risk of entrainment.

#### 26 ***CM6 Channel Margin Enhancement***

27 Restoration provided by *CM6 Channel Margin Enhancement* would be unlikely to provide additional  
28 rearing habitat, but an increase in downstream food resources for longfin smelt. While this would be  
29 considered potentially beneficial, longfin smelt would likely experience only minimal benefits  
30 because they tend to occur away from shore and are largely found downstream of the main channels  
31 proposed for channel margin enhancement. Similarly, the potential effects of exposure to toxins is  
32 also expected to be minimal.

#### 33 ***CM7 Riparian Natural Community Restoration***

34 The potential effects of *CM7 Riparian Natural Community Restoration* on longfin smelt are expected  
35 to be similar to those discussed for delta smelt (see Impact AQUA-9).

#### 36 ***CM10 Nontidal Marsh Restoration***

37 No direct benefits would be expected to accrue to longfin smelt as a result of CM10 Nontidal Marsh  
38 Restoration as they do not occur in non-tidal areas. However, as discussed under Impact AQUA-9 for  
39 delta smelt, some benefit may occur in proportion to their use of the downstream areas.

1 **Summary**

2 The effects of floodplain, tidal, channel margin and riparian habitat restoration activities on longfin  
3 smelt are likely to be similar to those discussed for delta smelt (see Impact AQUA-9) including  
4 increased habitat area and associated food resources. In general these effects are presumed to be  
5 not adverse or modestly beneficial for longfin smelt, although any benefits would minimal, because  
6 longfin smelt tend to occur in these habitat areas for brief periods.

7 Despite the improvements in habitat and habitat functions in the Delta from floodplain, tidal,  
8 channel margin and riparian habitat restoration activities, habitat quality is expected to decline in  
9 the LLT primarily because of climate change.

10 **NEPA Effects:** The overall effect of restoration activities is expected to remain not adverse for  
11 longfin smelt. However, it is important to note that any benefits would not be derived in all years,  
12 and that an adaptive management plan would be needed to determine an operational protocol that  
13 optimizes benefits both locally and in adjacent habitats.

14 **CEQA Conclusion:** As with delta smelt, the overall effects of floodplain, tidal, channel margin and  
15 riparian habitat restoration activities are expected to be beneficial for longfin smelt (see Impact  
16 AQUA-9) because of increased food production associated with the increased habitat and  
17 connectivity. While habitat quality is expected to decline in the LLT primarily because of climate  
18 change, the overall impact of restoration activities is expected to remain beneficial for longfin smelt  
19 because they increase habitat and food resources. Consequently, no mitigation is required.

20 **Other Conservation Measures (CM12–CM19 and CM21)**

21 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

22 Details associated with methylmercury are provided under Impact 8 and Impact 10. The potential  
23 effects of methylmercury management on longfin smelt are expected to be similar to those discussed  
24 for delta smelt (see Impact AQUA-10 as well as Impact AQUA-8). However, the magnitude of effects  
25 would likely be marginally less for longfin smelt, because of their reduced occurrence in the  
26 expected restoration areas, relative to the delta smelt.

27 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
28 **(CM13)**

29 The following analysis is based on the more detailed analysis included in *BDCP Effects Analysis –*  
30 *Appendix 5F, Biological Stressors, Section F.1.1 Invasive Aquatic Vegetation, Section F.4 Invasive*  
31 *Aquatic Vegetation, and F.5.3.2.3 Nonnative Aquatic Vegetation Control (Conservation Measure 13)*  
32 *(hereby incorporated by reference).*

33 A general analysis of the effects on covered fish species has been conducted that was described  
34 above for delta smelt (see Impact AQUA-11). Potential impacts on longfin smelt from IAV control  
35 during operations are similar to those discussed for delta smelt. Longfin smelt are predominantly  
36 found in deeper water habitats and do not commonly occupy shallow waters where IAV is found. For  
37 the small proportion of juveniles that do inhabit these shallow areas, removal of IAV could reduce  
38 presence of largemouth bass and hence reduce predation impacts on longfin smelt. The control of  
39 IAV with implementation of *CM13 Invasive Aquatic Vegetation Control* is expected to maintain or  
40 improve turbidity conditions that would potentially benefit longfin smelt rearing conditions,

1 reducing their susceptibility to predation. The control of IAV would also increase the amount of  
2 rearing habitat, as well as access to the habitat.

3 **NEPA Effects:** IAV control is expected to provide a potential benefit to longfin smelt.

4 **CEQA Conclusion:** While implementation of habitat restoration measures (under *CM2 Yolo Bypass*  
5 *Fisheries Enhancement*, *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally Inundated*  
6 *Floodplain Restoration*, and *CM6 Channel Margin Enhancement*) could allow IAV to become  
7 established and increase potential predation levels, implementation of IAV control measures under  
8 *CM13 Invasive Aquatic Vegetation Control* are expected to substantially reduce this potential effect.  
9 The control of IAV should provide a modest net benefit to longfin smelt by decreasing predator  
10 habitat and increasing turbidity. Increased turbidity is expected to reduce the effectiveness of  
11 predators to prey on longfin smelt. In addition, controlling IAV is expected to increase the spawning  
12 and/or rearing habitat for longfin smelt. Therefore, the control of IAV is expected to have a slight  
13 beneficial effect on longfin smelt, consequently, no mitigation would be required.

#### 14 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

15 As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very similar to Existing  
16 Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP export service areas  
17 (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14 Stockton Deepwater*  
18 *Ship Channel Dissolved Oxygen Levels* management would improve the aquatic habitat conditions for  
19 fish in the river. Longfin smelt can occur in the channel and the increased dissolved oxygen levels  
20 could also provide improved habitat conditions for them which would be a benefit.

21 **NEPA Effects:** The effect of dissolved oxygen level management on longfin smelt would likely be  
22 beneficial.

23 **CEQA Conclusion:** As discussed in Chapter 8, *Water Quality*, *CM14 Stockton Deepwater Ship Channel*  
24 *Dissolved Oxygen Levels* management would improve the upstream migration conditions for fall-run  
25 Chinook salmon and steelhead in the San Joaquin River basin. Longfin smelt can occur in the channel  
26 and the increased dissolved oxygen levels also provide improved habitat conditions for them, which  
27 would be a benefit. Consequently, no mitigation would be required.

#### 28 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

29 To the extent that localized predator control efforts of *CM15 Localized Reduction of Predatory Fish*  
30 reduce the overall abundance of fish predators in the Delta occupied by longfin smelt, it is possible,  
31 but not assured that there would be some reduction in losses to predation, although no quantitative  
32 information is available regarding the current magnitude of longfin smelt loss to predation (see  
33 Impact AQUA-13).

34 **NEPA Effects:** Due to the uncertainties of longfin smelt loss to predation, there would be no  
35 demonstrable effect of this conservation measure on longfin smelt.

36 **CEQA Conclusion:** Due to the uncertainties concerning overall fish predator reduction and actual  
37 predation rates on longfin smelt in the Delta, there would be no demonstrable effect from this  
38 conservation measure on longfin smelt. Consequently, no mitigation would be required.

1 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

2 Potential impacts on longfin smelt from the installation of NPBs are expected to be similar to those  
3 for delta smelt (see Impact AQUA-14) including that NPBs are not designed to deter longfin smelt  
4 and because they are too small to be effectively deterred.

5 **NEPA Effects:** There would be no demonstrable effect of NPBs on longfin smelt.

6 **CEQA Conclusion:** Potential impacts on longfin smelt from the installation of NPBs are expected to  
7 be similar to those for delta smelt (see Impact AQUA-14) including that NPBs are not designed to  
8 deter longfin smelt and because they are too small to be effectively deterred. There would be slight  
9 reductions in entrainment and they would not be subject to the salvage process which is generally  
10 inefficient. Therefore, we conclude that there would be no demonstrable effect on this conservation  
11 measure on longfin smelt. Consequently, no mitigation would be required.

12 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

13 *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley steelhead, green  
14 sturgeon and white sturgeon and are expected to have positive effects on their populations.

15 **NEPA Effects:** Because CM17 is not applied to longfin smelt it would have no direct effect on them.  
16 Therefore, this effect is not adverse.

17 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
18 Valley steelhead, green sturgeon and white sturgeon and are expected to have positive effects on  
19 their populations. Since this conservation measure is not applied to longfin smelt it would have no  
20 direct effect on them. Consequently, no mitigation would be required.

21 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

22 *CM18 Conservation Hatcheries* would establish new and expand existing captive conservation  
23 propagation programs for delta and longfin smelt. Two programs would be supported. One, a  
24 conservation hatchery to house a delta smelt refugial population and to provide a source of delta  
25 smelt and longfin smelt for experimentation, supplementation or reintroduction if deemed  
26 necessary by wildlife agencies. Two, expansion of the refugial population of delta smelt and  
27 establishment of an experimental population of longfin smelt at the University of California Davis  
28 Fish Conservation and Culture Laboratory in Byron. There is no evidence that capturing wild longfin  
29 smelt for experimental purposes would be harmful at the population level.

30 **NEPA Effects:** If longfin smelt abundance continues to decline then this experimental population  
31 would be beneficial for longfin smelt.

32 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing captive  
33 conservation propagation programs for longfin smelt. Two programs include a conservation  
34 hatchery for refugial longfin smelt (as well as to provide a population for experimentation) and to  
35 establish an experimental population at the Byron facility. There is no evidence that capturing wild  
36 longfin smelt for experimental purposes would be harmful at the population level. If longfin smelt  
37 abundance continues to decline then this experimental population would be beneficial for longfin  
38 smelt. Consequently, no mitigation would be required.

1 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

2 The effects of urban stormwater treatment (CM19) would reduce contaminants associated with  
3 urban areas because it provides for the treatment of stormwater discharges. As discussed in Chapter  
4 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
5 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
6 urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and other  
7 contaminants. These reductions would contribute to improved water quality in the Delta.

8 **NEPA Effects:** Based on the improved overall water quality conditions and reduced pesticides the  
9 effect would be beneficial.

10 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
11 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
12 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
13 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
14 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
15 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore  
16 the impacts of urban stormwater treatment would be beneficial because it would have a beneficial  
17 effect both directly and through habitat modifications on longfin smelt. Consequently, no mitigation  
18 would be required.

19 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
20 **(CM21)**

21 The BDCP may affect entrainment at other diversions by altering Delta hydrodynamics and  
22 transport of larvae. As described for delta smelt, the cumulative effect of multiple agricultural  
23 diversions operating over a large proportion of the year may result in losses of longfin smelt, with  
24 more substantial effects on larvae. However, these losses may be low relative to those of delta smelt  
25 because longfin smelt generally exit the Delta earlier than delta smelt, thereby avoiding exposure to  
26 agricultural diversions when they are operating at capacity.

27 Entrainment of particles representing longfin smelt larvae at Delta agricultural diversions ranged  
28 from approximately 0 to over 10%. In nearly all PTM runs, there was lower entrainment under  
29 Alternative 1A scenarios than baseline scenarios. The average decrease in entrainment under  
30 Alternative 1A scenarios compared to baseline scenarios ranged from 2.3 to 3.5%, whereas the  
31 average increase under Alternative 1A scenarios was much less (0.0–0.1%). This reduction is  
32 uncertain because particle tracking is not necessarily an accurate representation of smelt larval  
33 behavior in relation to agricultural intakes.

34 There is no evidence of substantial entrainment of covered fish species at agricultural diversions in  
35 the Plan Area, but some entrainment likely is occurring. Whatever entrainment is occurring would  
36 be reduced by decommissioning agricultural diversions in the BDCP ROAs. PTM modeling and  
37 extrapolations to a hypothetical number of diversions to be removed from the ROAs (i.e.,  
38 approximately 4–12% of diversions) gave estimates of up to a 1% reduction in overall loss of longfin  
39 smelt larvae because of such decommissioning. Due to the earlier exit of longfin smelt from the  
40 Delta, compared to delta smelt, similar reductions would be a conservative estimate for longfin  
41 smelt. This reduction is uncertain because particle tracking is not necessarily an accurate  
42 representation of smelt larval behavior in relation to agricultural intakes.

1 **NEPA Effects:** It is concluded based on the results above that the effect of removal/relocation of  
2 nonproject diversions is not adverse and may be beneficial.

3 **CEQA Conclusion:** There is no evidence of substantial entrainment of covered fish species at  
4 agricultural diversions in the Plan Area, but some entrainment likely is occurring. Whatever  
5 entrainment is occurring would be reduced by decommissioning agricultural diversions in the ROAs.  
6 PTM modeling and extrapolations to a hypothetical number of diversions to be removed from the  
7 ROAs (i.e., approximately 4–12% of diversions) gave estimates of up to a 1% reduction in overall  
8 loss of longfin smelt larvae because of such decommissioning. Due to the earlier exit of longfin smelt  
9 from the Delta, compared to delta smelt, similar reductions would be a conservative estimate for  
10 longfin smelt. This reduction is uncertain because particle tracking is not necessarily an accurate  
11 representation of smelt larval behavior in relation to agricultural intakes. Therefore,  
12 removal/relocation of nonproject diversions would be considered a beneficial impact because it  
13 would reduce entrainment which would have a positive impact on longfin smelt numbers.  
14 Consequently, no mitigation would be required.

### 15 **Chinook Salmon**

16 As noted in *Environmental Setting/Affected Environment*, four races of Chinook salmon can occur in  
17 the vicinity of in-water work for the intakes: Sacramento winter, spring, fall, and late fall–run ESUs  
18 (see Table 11-4). The area of the Sacramento River affected by construction of the intakes is  
19 primarily a migratory corridor for adult salmon returning to upriver spawning habitat and juvenile  
20 salmon outmigrating from upriver habitats to the ocean. Each of these Chinook salmon races uses  
21 the Delta as migratory and rearing habitat during the migrant adult and juvenile periods of their  
22 respective life histories, implying that they would be subject to a similar range of effects from  
23 project construction. However, the duration, extent, and timing of occurrence in the lower  
24 Sacramento River and the Delta varies between these races, meaning that they would be subject to  
25 different stressor exposure and therefore would be subject to a different range of potential effects.  
26 Appendix 11A, *Covered Fish Species* details the temporal and spatial distribution of various life  
27 history stages for the Chinook salmon ESUs.

28 Adult and juvenile migrations past the intake locations in the lower Sacramento River occur as  
29 follows.

- 30 ● Winter-run
  - 31 ○ Adults – December through June, with peak in March
  - 32 ○ Juveniles – November through May, with peak November through January
- 33 ● Spring-run
  - 34 ○ Adults –February through September, with peak in April and May
  - 35 ○ Juveniles – November through May, with peak November through January
- 36 ● Fall-run
  - 37 ○ Adults – June through December, with peak in September through November
  - 38 ○ Juveniles – November through September, with peak in February through May

- 1     • Late fall–run
- 2         ○ Adults – October through April, with peak in December through February
- 3         ○ Juveniles – May through February, with peak in October through February

4     Timing restrictions for in-water construction activities (typically restricted to the June through  
5     October period) would avoid the peak migration periods for all Chinook salmon life history types,  
6     with the exception of fall-run adult migrants, which would be likely to occur in areas proposed for  
7     construction in September or October. There is also some potential overlap in construction timing  
8     with early (late fall–run) or late (spring-run) upriver migrants, and with late emigrating juveniles  
9     from any of these population types as well. In general, the numbers of Chinook salmon potentially  
10    migrating past the site of the intakes during the expected in-water construction window would  
11    generally be small in comparison to the overall size of the migratory population.

12    Ongoing construction activities at tunnel shaft locations in the Delta will require routine barge trips,  
13    resulting in noise, disturbance and water quality impacts associated with vessel operations. These  
14    activities will take place year-round. Juvenile Chinook salmon and occasionally adult Chinook  
15    salmon also may be present near the barge landings during the in-water construction of barge  
16    landing sites, and are likely to be present in areas and at times where routine barge traffic would  
17    occur. The likelihood of exposure to construction-related effects would be minimized by adherence  
18    to the in-water work window, for in-water construction activities. In addition, the noise levels  
19    generated by barge and non-pile driving construction activities would not be expected to reach  
20    levels that would adversely affect Chinook salmon.

21    The three ESUs of Chinook salmon are treated for the purposes of this analysis as distinct species.

## 22    **Winter-Run Chinook Salmon**

### 23    **Construction and Maintenance of CM1**

#### 24    **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 25    **(Winter-Run ESU)**

##### 26    *Temporary Increases in Turbidity*

27    Construction of Alternative 1A would unavoidably result in the generation and release of suspended  
28    sediments to the water column. Increased suspended sediments will temporarily increase water  
29    column turbidity, altering habitat conditions for Chinook salmon and other fish species. Small  
30    portion of the migratory adult and migrating and rearing juvenile Chinook salmon life history stages  
31    would be exposed to construction-related turbidity effects, as these stages would occur within the  
32    area affected by implementation of Alternative 1A.

33    As discussed previously, turbidity is a measure of the scattering of light penetration by dissolved  
34    and particulate organic and inorganic matter in the water column, including, but not limited to  
35    suspended sediments. However, the term is commonly used to describe suspended sediment effects  
36    associated with construction and is applied accordingly here.

37    The effects of turbidity on salmonids can vary significantly depending on a number of factors,  
38    including the magnitude of the effect relative to baseline turbidity conditions, and species- and life  
39    stage-specific sensitivity. Low levels of turbidity can actually be beneficial to salmonids by providing  
40    cover from predation during foraging activities (DeRobertis et al. 2003). As turbidity levels increase

1 however, vision becomes sufficiently obscured that foraging success and predator avoidance can  
2 decrease, resulting in behavioral avoidance and stress. Higher turbidity levels can clog gill tissues,  
3 interfering with respiration and increasing physiological stress. Very high turbidity levels can  
4 directly damage gill tissues, resulting in overt physical injury and even death.

5 The construction activities that could result in temporary increases in turbidity are discussed above  
6 in Impact AQUA-1 for delta smelt, and in Chapter 8, *Water Quality*. These activities would occur  
7 during the expected in-water construction window (typically June 1 and October 31) to minimize  
8 the potential effects on Chinook salmon. This timing avoids the peak timing of most juvenile and  
9 adult Chinook salmon migrations. However, there is some overlap between construction timing at  
10 the Sacramento River intake locations and the late downstream migration of juveniles in June, and  
11 some variable overlap in the upstream migrations of winter-, spring-, and fall-run Chinook salmon  
12 adults. Low numbers of juvenile Chinook salmon could also be present in the Delta during  
13 construction of the tunnel shafts and barge landings, and are likely to be present during the year-  
14 round barge operations during construction.

15 This indicates that some level of Chinook salmon exposure to construction-related turbidity is likely  
16 to occur. However, this exposure is not expected to be of sufficient intensity and duration to result in  
17 adverse effects on either juvenile or adult Chinook. Timing restrictions will avoid exposure to the  
18 majority of turbidity-related effects, and the extent of these effects would also be avoided and  
19 minimized by implementing the environmental commitments *Environmental Training; Stormwater*  
20 *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*  
21 *Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel*  
22 *Material, and Dredged Material; and Barge Operations Plan* (see Appendix 3B, *Environmental*  
23 *Commitments* and Impact AQUA-1 for delta smelt for details of these plans).

#### 24 **Accidental Spills**

25 Construction-related activities may affect water quality due to accidental spills of contaminants,  
26 including cement, oil, fuel, hydraulic fluids, paint, and other construction-related materials.  
27 Depending on the type and magnitude of an accidental spill, contaminants can directly affect growth  
28 and survival of Chinook salmon. Effects on Chinook salmon from accidental spills during  
29 construction would be similar to those described for delta smelt (see Impact AQUA-1). Effects would  
30 be minimized by implementing the environmental commitments described under Impact AQUA-1  
31 for delta smelt and in Appendix 3B, *Environmental Commitments (Environmental Training;*  
32 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
33 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan)*, specifically the *Spill*  
34 *Prevention, Containment, and Countermeasure Plan*.

#### 35 **Disturbance of Contaminated Sediments**

36 Toxic contaminants are present in both water and sediment in the Delta aquatic environment, as  
37 described in Chapter 8, *Water Quality*. In-water construction activities would suspend sediments  
38 that may contain toxic contaminants (see discussion under Impact AQUA-1 for delta smelt).  
39 Potential effects on Chinook salmon from disturbance of contaminated sediments during  
40 construction are similar to those described for delta smelt (Impact AQUA-1). Effects would be  
41 minimized by implementation of environmental commitments described under Impact AQUA-1 for  
42 delta smelt and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater*  
43 *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*

1 *Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel*  
2 *Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan).*

### 3 **Underwater Noise**

4 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
5 fish, including Chinook salmon (see Impact AQUA-1). Table 11-4 illustrates the species and life  
6 stages of Chinook salmon present in the north, east, and south Delta during the in-water  
7 construction window (expected to be June 1–October 31). Winter-run, spring-run, fall-run and late  
8 fall-run Chinook salmon eggs and fry would not experience underwater sound because the locations  
9 of the intakes and barge landings are not considered suitable habitat for these two life stages of this  
10 species, and they would not be present during the expected in-water construction period (June to  
11 October). Therefore, these life history stages would not be affected.

12 Adult winter- and spring-run Chinook salmon could be present near the construction areas of the  
13 intakes during a portion of the in-water work window (June and July) toward the end of their  
14 upstream migration period. However, adult fall-run Chinook salmon could occur during a much  
15 larger portion of the work window (July through October). Most juvenile Chinook salmon would  
16 likely occur in low abundance during in-water construction periods in the north Delta.

17 Table 11-8 illustrates the estimated area where the cumulative SEL injury threshold would be  
18 exceeded if impact pile driving is required during construction. All juveniles exposed to underwater  
19 noise would be expected to be larger than the 2-gram size threshold, based on the typical length at  
20 age and the length to weight relationship observed for Chinook salmon occurring in the Delta  
21 (Myers et al. 1998; Kimmerer et al. 2005). On this basis, juveniles exposed to underwater noise in  
22 excess of the effects threshold of 187 dB SEL<sub>cumulative</sub> would be expected to experience injury-level  
23 adverse effects. These effects would be avoided and minimized through implementation of  
24 Mitigation Measures AQUA-1a and/or AQUA-1b.

### 25 **Fish Stranding**

26 Adult Chinook salmon and juvenile winter-run Chinook salmon in the Plan area would not be  
27 expected to occur in the vicinity of cofferdam placement when these activities take place. The risk of  
28 fish entrapment and subsequent handling stress during removal would be minimized by limiting  
29 cofferdam construction and other in-water work to the expected in-water work window (June 1  
30 through October 31). Adverse effects would also be minimized through the implementation of  
31 environmental commitment *Fish Rescue and Salvage Plan* (see Impact AQUA-1 and Appendix 3B,  
32 *Environmental Commitments*).

### 33 **In-Water Work Activities**

34 As discussed for delta smelt (see Impact AQUA-1), in-water work activities have the potential to  
35 adversely affect fish through physical injury from direct exposure to excavation, materials  
36 placement, vessel grounding, or other construction related effects, or behavioral alteration  
37 associated with these disturbances. Behavioral disturbances could temporarily alter or delay  
38 migration behavior during construction activities. Any such delays would be limited in frequency,  
39 short in duration, and would take place during periods when few Chinook salmon are expected to be  
40 present. Therefore, while adverse effects cannot be entirely discounted, these temporary and  
41 intermittent effects would apply to individual fish, but would be unlikely to affect the population as a  
42 whole, or reduce the viability of the population in the long-term. affected will be limited.

1 Furthermore, effects would be minimized by implementation of environmental commitments  
2 described in Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment Control*  
3 *Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*.  
4 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

#### 5 ***Loss of Spawning, Rearing, or Migration Habitat***

6 As noted in Impact AQUA-1 for delta smelt, in-water construction would temporarily or  
7 permanently alter the condition of migratory and rearing habitats in the vicinity of the construction  
8 activities. The mainstem Sacramento River is designated as critical habitat for all runs of Chinook  
9 salmon, providing migration and rearing habitat. Approximately 28.7 acres of in-water habitat and  
10 22,700 linear feet of shoreline habitat would be temporarily inaccessible during in-water work (see  
11 Table 11-5). No suitable Chinook salmon spawning habitat is found in the vicinity of the proposed  
12 in-water work; therefore, construction would not affect Chinook salmon spawning habitat.  
13 Construction of the approach canal and Byron Tract Forebay would not affect fish-accessible  
14 waterways and therefore would not affect Chinook salmon. Nevertheless, potential effects would be  
15 minimized by implementation of environmental commitments described in Appendix 3B,  
16 *Environmental Commitments*, including *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable*  
17 *Tunnel Material, and Dredged Material*; and *Barge Operations Plan*. Pertinent details of these plans  
18 are provided under Impact AQUA-1 for delta smelt.

#### 19 ***Predation***

20 As discussed under Impact AQUA-1 for delta smelt, temporary in-water pilings and over-water  
21 structures and local temporary increases in turbidity associated with the construction of Alternative  
22 1A may create conditions that could have a localized effect on predation rates of juvenile Chinook  
23 salmon. Specifically, temporary overwater and in-water structures would temporarily increase the  
24 amount of cover and/or perching areas available for predators. These effects would be most  
25 pronounced at the tunnel shaft sites (the vertical wall cofferdams constructed at the intakes would  
26 not be expected to provide effective cover for predatory fish). This could theoretically lead to a  
27 localized increase in predator density sufficient to affect predation rates on juvenile Chinook  
28 salmon. However, a measurable effect on predation rates is unlikely to occur for the following  
29 reasons.

- 30 ● The increase in over-water and in-water structure area is incrementally small in comparison to  
31 the NAA, meaning that any localized effect on predation rate would be difficult to measure.
- 32 ● Predator concentration and predation effectiveness would be constrained to a certain extent by  
33 the ongoing disturbance associated with construction activity.

34 Project construction is also expected to result in periodic short-term turbidity pulses during in-  
35 water construction. This could have a variable and offsetting effect on predation rates, depending on  
36 the intensity and duration of the turbidity pulse. Low levels of turbidity may actually reduce  
37 predation rates on juvenile Chinook salmon by providing visual cover. In contrast, predation  
38 exposure could increase if turbidity reaches levels sufficient to induce behavioral avoidance, forcing  
39 juveniles to abandon habitats that provide cover from predation. The net effect of anticipated  
40 turbidity levels on predation rates is difficult to predict. However, because turbidity levels would be  
41 carefully managed to avoid direct adverse effects on juvenile Chinook salmon, the likelihood of  
42 biologically significant indirect effects on predation rates is expected to be negligible.

1       **Summary**

2       Construction of Alternative 1A involves several elements with the potential to cause adverse effects  
3       on Chinook salmon. However, these effects will be effectively avoided, minimized and/or mitigation  
4       in most cases through implementation of appropriate environmental commitments, conservation  
5       measures, and mitigation measures. Construction-related turbidity and underwater noise associated  
6       with impact pile driving are the most geographically extensive potential effects, with underwater  
7       noise having the greatest potential for adverse effects on Chinook salmon.

8       The majority of potential construction-related adverse effects will be avoided and minimized by  
9       construction timing. The in-water work window will minimize Chinook salmon exposure to water  
10       quality and disturbance related stressors by limiting in-water construction activities to a time  
11       period when Chinook salmon are least likely to be present in the vicinity. In addition, several  
12       environmental commitments will be implemented that will avoid and minimize adverse effects by  
13       controlling the duration and magnitude of construction related impacts (see Appendix 3B,  
14       *Environmental Commitments*). These include *Environmental Training; Stormwater Pollution*  
15       *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
16       *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*  
17       *Dredged Material*; and development and implementation of a barge operations plan designed to  
18       avoid turbidity generation and shoreline erosion from propeller wash and vessel wakes (see  
19       Appendix 3B *Environmental Commitments: Barge Operations Plan*). Pertinent details of these plans  
20       are provided under Impact AQUA-1 for delta smelt. These timing restrictions and environmental  
21       commitments are expected to avoid adverse effects on Chinook salmon from construction-related  
22       turbidity, accidental spills, and re-suspension and redistribution of potentially contaminated  
23       sediments.

24       Underwater noise associated with pile driving has the greatest potential for adverse effects on  
25       Chinook salmon. In general, timing restrictions would limit pile driving to periods when Chinook  
26       salmon are least likely to be present in the vicinity of planned activities. Adult winter-, spring-, and  
27       fall-run Chinook salmon could occur in the area during the in-water work window, and have a  
28       reasonable probability of exposure to underwater noise effects, although their occurrence during  
29       this time period is expected to be limited. Adult Chinook would also likely be migrating rapidly  
30       through the Delta and the Sacramento River when pile driving activities could be taking place,  
31       meaning that the opportunity for cumulative SEL exposure would be limited and exceedances of the  
32       cumulative exposure criterion are unlikely. They may experience short delays in migration past the  
33       intakes when pile driving is occurring; however, pile driving would occur only intermittently  
34       through a portion of the day, and minor migration delays would be unlikely affect their ability to  
35       successfully reach spawning grounds. These adverse effects would be further avoided and  
36       minimized by restricting impact pile driving to the minimum amount required for construction, and  
37       through implementation of the avoidance and minimization measures included in Mitigation  
38       Measures AQUA-1a and AQUA-1b. Chinook salmon migratory behavior (seasonal and daily timing)  
39       would also be expected to limit the likelihood of adverse effects. While adverse effects may occur to  
40       individual fish, there is no indication that the effects would adversely affect the overall population or  
41       the long-term viability of the population.

42       The likelihood of juvenile winter-run Chinook salmon being in the vicinity when impact driving  
43       could take place is low. In addition to their timing in the Delta, the habitat at the intake and barge  
44       landing locations is considered poor because of relatively steep rip rap banks and deep channels  
45       with little refuge, which may further limit the overall abundance of juvenile Chinook salmon.

1 Therefore, the potential for juvenile winter-run Chinook salmon to experience an adverse effect  
2 (e.g., injury or mortality, or migratory disturbance) would be low because of their low temporal and  
3 spatial migration distribution around the intake and barge facility construction areas, and the  
4 intermittent nature of potential exposure above the threshold criterion. While underwater noise  
5 from impact pile driving could affect individual Chinook salmon, the effect would be unlikely to  
6 adversely affect Chinook salmon populations. Therefore, the effect would not be adverse.

7 Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge Operations*  
8 *Plan* (as described in Appendix 3B) would also offset potential effects of construction activities on  
9 Chinook salmon. Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.  
10 Construction of the approach canal and Byron Tract Forebay would not affect fish-accessible  
11 waterways and therefore would not affect Chinook salmon. As a result, these construction activities  
12 would not be expected to result in adverse effects on Chinook salmon.

13 The construction of the intakes and barge landings will temporarily affect rearing and migration  
14 habitat, and the intakes screens will permanently alter habitat in the Sacramento River. Despite the  
15 relatively poor quality of the current habitat, it is designated critical habitat for Chinook salmon.  
16 However, implementation of *CM6 Channel Margin Enhancement* would enhance channel margin  
17 habitat along 20 miles of the Sacramento River, including the vicinity of the intake structures, and  
18 would be designed to result in a net improvement in channel margin habitat function. Therefore, the  
19 temporary and permanent effects on rearing and migration habitat would not be expected to  
20 adversely affect Chinook salmon populations.

21 **NEPA Effects:** Overall, the effect would not be expected to be adverse for winter-run Chinook  
22 salmon.

23 **CEQA Conclusion:** The potential impact on Chinook salmon from construction activities would be  
24 considered less than significant due to implementation of the environmental commitments  
25 described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*,  
26 such as *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control*  
27 *Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure*  
28 *Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage*  
29 *Plan; and Barge Operations Plan*. These measures would be expected to protect Chinook salmon  
30 from any adverse water quality effect (turbidity, hazardous spills) resulting from project  
31 construction. Construction would not be expected to increase predation rates relative to Existing  
32 Conditions. Construction associated with Alternative 1A will result in both temporary and  
33 permanent alteration of rearing and migratory habitats used by Chinook salmon. However, these  
34 effects are not expected to be significant because the loss of habitat is not substantial compared to  
35 the amount of habitat currently available in combination with the amount of new habitat that would  
36 result from restoration. The direct effects of underwater construction noise on Chinook salmon  
37 would be a significant impact because of the high likelihood that it would cause injury or death to  
38 most impacted fish in the immediate vicinity of the activity. However, implementation of Mitigation  
39 Measures AQUA-1a and AQUA-1b would minimize the potential effects from underwater noise and  
40 would reduce the severity of impacts to a less-than-significant level.

41 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
42 **of Pile Driving and Other Construction-Related Underwater Noise**

43 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

4           **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
5           **(Winter-Run ESU)**

6           ***Temporary Increases in Turbidity***

7           As discussed for construction-related effects of turbidity on salmonids (Impact AQUA-37), increased  
8           turbidity could result in a decreased ability to forage or physical injury to the gills. However,  
9           increased turbidity can also decrease predation rates by sight predators, potentially increasing  
10          survival rates. In-water maintenance activities would typically occur between June 1 and October 31  
11          when winter-run Chinook salmon are minimally present in the Sacramento River. In-water activities  
12          would be limited in duration and infrequent. Effects would also be minimized by implementing the  
13          environmental commitments described in Appendix 3B, *Environmental Commitments*  
14          (*Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
15          *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;*  
16          *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and*  
17          *Barge Operations Plan*). Pertinent details of these plans are provided under Impact AQUA-1 for delta  
18          smelt.

19          ***Accidental Spills***

20          The potential effects of maintenance activities would be similar to those discussed for construction-  
21          related effects (see Impact AQUA-1 for delta smelt). Effects would be minimized by implementing  
22          the environmental commitments in Appendix 3B, *Environmental Commitments*. These  
23          environmental commitments include *Environmental Training; Stormwater Pollution Prevention Plan;*  
24          *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
25          *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
26          *Material; and Barge Operations Plan*. Pertinent details of these plans are provided under Impact  
27          AQUA-1 for delta smelt.

28          ***Underwater Noise***

29          As discussed for delta smelt (see Impact AQUA-2 for delta smelt), underwater noise levels produced  
30          by in-water maintenance activities are not expected to reach a level that would harm juvenile or  
31          adult fishes. NMFS has found that underwater sound pressure levels less than the 150 dB RMS  
32          behavioral effects threshold may result in temporary altered behavior of fishes indicative of stress  
33          but would not result in permanent harm or injury (National Marine Fisheries Service 2001).

34          ***Maintenance-Related Disturbance***

35          The potential effects of in-water maintenance activities would be similar to those discussed for  
36          construction-related effects (see Impact AQUA-2 for delta smelt). Effects would be minimized by  
37          implementing environmental commitments described under Impact AQUA-1 for delta smelt and in  
38          Appendix 3B, *Environmental Commitments*, and by limiting the use of these habitats to during the  
39          expected in-water construction window. These environmental commitments include *Environmental*  
40          *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*

1 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Barge*  
2 *Operations Plan.* Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

### 3 ***Loss of Spawning, Rearing, or Migration Habitat***

4 Two maintenance activities, dredging and riprap placement, would reduce habitat values in the area  
5 around the intakes. Removal of sediment would decrease the number of macroinvertebrates around  
6 the intakes. This could cause a temporary loss of prey resources of juvenile Chinook salmon, and a  
7 temporary reduction in migration habitat. However available rearing and migration habitat of  
8 similar quantity and quality would be readily accessible to Chinook salmon in adjacent areas. These  
9 maintenance activities would also occur when few Chinook would occur in the area, and the habitat  
10 would recover relatively quickly. In addition, no Chinook salmon spawning habitat occurs in these  
11 areas. Furthermore, potential effects would be minimized by implementation of environmental  
12 commitments described in Appendix 3B, *Environmental Commitments*. These environmental  
13 commitments include *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and*  
14 *Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
15 *Countermeasure Plan; and Dispose of Spoils, Reusable Tunnel Material, and Dredged Material.*  
16 Pertinent details of these plans are provided under Impact AQUA-1.

### 17 ***Predation***

18 Maintenance activities would be unlikely to have any measurable effect on winter-run Chinook  
19 predation rates. These activities may include the use of barges and other watercraft that could  
20 theoretically provide cover, shelter, and perching areas for winter-run Chinook predators. However,  
21 the limited duration of maintenance activities and the associated noise and disturbance would be  
22 expected to dissuade predators from concentrating at sufficient density to measurably affect  
23 predation rates on winter-run Chinook.

### 24 ***Summary***

25 In-water maintenance activities would be scheduled to occur when the least numbers of Chinook  
26 salmon would be present in or near the maintenance areas. Such activities would include  
27 maintenance dredging at the intake sites, and installation or repair of riprap bank armoring.  
28 Implementing the environmental commitments described in Appendix 3B, *Environmental*  
29 *Commitments*, would further minimize or eliminate effects on Chinook salmon by reducing the  
30 amount of turbidity and guiding the rapid and effective response in the case of inadvertent spills of  
31 hazardous materials. These environmental commitments include *Environmental Training;*  
32 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
33 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
34 *Reusable Tunnel Material, and Dredged Material.* Pertinent details of these plans are provided under  
35 Impact AQUA-1 for delta smelt.

36 Implementation of these environmental commitments, along with the low numbers of Chinook  
37 salmon expected to occur in the maintenance areas during the expected in-water work windows and  
38 the limited frequency and duration of in-water maintenance activities, would result in a very low  
39 potential for adverse effects on Chinook salmon. In addition, no spawning habitat occurs in the areas  
40 potentially affected by maintenance activities, and ample rearing, and migration habitat of the same  
41 quality is readily accessible in the area, and this habitat would not be affected by maintenance  
42 activities.

1 **NEPA Effects:** The short-term maintenance activities would not adversely affect Chinook salmon  
2 populations.

3 **CEQA Conclusion:** In addition to the limited frequency and duration of in-water maintenance  
4 activities, implementation of the commitments identified above and described in detail in Appendix  
5 3B, *Environmental Commitments*, would minimize the potential for maintenance activities to affect  
6 Chinook salmon populations by reducing the amount of turbidity and guiding the rapid and effective  
7 response to inadvertent spills of hazardous materials. These environmental commitments,  
8 described in greater detail under Impact AQUA-1 for delta smelt, include *Environmental Training*;  
9 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
10 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; and *Disposal of Spoils*,  
11 *Reusable Tunnel Material*, and *Dredged Material*. Potential changes to rearing and migratory habitat  
12 would also be limited and temporary. Therefore, the potential impact of maintenance activities is  
13 considered less than significant because it would not substantially reduce Chinook salmon habitat,  
14 restrict its range, or interfere with its movement. Consequently, no mitigation would be required.

### 15 **Water Operations of CM1**

#### 16 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter- 17 Run ESU)**

##### 18 ***Water Exports from SWP/CVP South Delta Facilities***

19 An entrainment index of winter-run Chinook salmon at the South Delta facilities was estimated  
20 using the salvage-density method and normalized by measures of annual adult population  
21 abundance in the year of entrainment (as detailed in *BDCP Effects Analysis - Appendix 5.B, Section*  
22 *5.B.4, herein incorporated by reference*). Under NAA, losses of juvenile winter-run Chinook salmon  
23 begin in December, peak in March at both facilities, and sharply decline in April.

24 The average entrainment index under Alternative 1A would be reduced by 60% across all water  
25 years compared to NAA (Table 11-1A-9). Entrainment would be substantially reduced in wet, above-  
26 normal, and below-normal water year types (50-87% less than NAA) and would be slightly reduced  
27 in dry and critical water year types (7-8% less than NAA). Pre-screen predation losses at the south  
28 Delta facilities would also decrease commensurate with the reductions in entrainment described  
29 above.

30 To put this into context, the relative magnitude of entrainment loss, as estimated by salvage density,  
31 can be compared with a general index of juvenile population abundance (as detailed in *BDCP Effects*  
32 *Analysis - Appendix 5.B, Section 5B.5.4.4, herein incorporated by reference*). For winter-run Chinook  
33 salmon, NMFS calculates a juvenile production estimate of juveniles passing Red Bluff Diversion  
34 Dam (mean value 1994 to 2009 about 1 million fish) and assumes 50% mortality during  
35 downstream migration. The general index of winter-run juvenile abundance reaching the Delta is  
36 500,000 fish. Proportional losses averaged across all years were 1.4% under NAA and decreased to  
37 0.5–0.6% under Alternative 1A scenarios.

1 **Table 11-1A-9. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index<sup>a</sup> at the**  
 2 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 1A**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-9,862 (-87%)	-10,282 (-87%)
Above Normal	-5,115 (-77%)	-5,239 (-78%)
Below Normal	-3,827 (-53%)	-3,403 (-50%)
Dry	-569 (-15%)	-262 (-8%)
Critical	-213 (-17%)	-74 (-7%)
All Years	-4,129 (-61%)	-4,069 (-60%)

Shading indicates >10% increased entrainment.

Note: Estimated annual index of fish lost, based on normalized salvage densities.

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 Entrainment of winter-run Chinook salmon at the north Delta intakes would occur only under the  
 6 action alternatives, including Alternative 1A, because there are no north Delta intakes operational  
 7 under NAA conditions. The north Delta intakes would be screened to exclude juvenile fish, including  
 8 juvenile winter-run Chinook salmon. The state-of-the-art, positive barrier screens would be  
 9 designed and built to specifications developed to reduce the risk of entrainment and impingement,  
 10 and are expected to be effective at excluding all life stages of winter-run Chinook salmon that would  
 11 occur in the vicinity including juveniles outmigrating during December-April (as evaluated in *BDCP*  
 12 *Effects Analysis – Appendix 5B, Entrainment, Section B.6.2.1, hereby incorporated by reference*). The  
 13 timing of occurrence would be similar to that discussed above for the south Delta facilities, typically  
 14 December-April, and peaking in March. The project’s adaptive management plan includes  
 15 monitoring of the new screens to determine their effectiveness. If the screens are not meeting  
 16 expectations, additional measures may be implemented to improve screen performance, such as  
 17 modifications to the screens or other structural components at the intakes, or changes in water  
 18 diversion operations to reduce entrainment or impingement rates of juvenile winter-run Chinook  
 19 salmon.

20 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

21 Entrainment of winter-run Chinook salmon (juveniles and smolts) at the North Bay Aqueduct has  
 22 not been explicitly analyzed. However, the Barker Slough Pumping Plant is screened for fish >25mm  
 23 and the alternative intake would presumably have screens of 1.75-m mesh. Based on the north Delta  
 24 intake analysis (*BDCP Effects Analysis – Appendix 5B Entrainment, Section B.5.9 Entrainment and*  
 25 *Impingement (SWP/CVP North Delta Intakes), hereby incorporated by reference*), it would be  
 26 expected to be 100% screened for salmon based on typical fish size and mesh size.

27 Monitoring would occur to ensure that fish are indeed being excluded according to the design  
 28 specifications. If monitoring indicates that screen effectiveness is not meeting expectations, the  
 29 BDCP-proposed Real-Time Response Team would implement additional measures to reduce  
 30 entrainment or impingement, such as modifications to the screens or intakes, or changes in water  
 31 diversion operations. Based on the aforementioned analysis and assumptions, additional measures  
 32 to reduce entrainment would not be necessary.

**NEPA Effects:** Alternative 1A would reduce entrainment of juvenile winter-run Chinook salmon at the South Delta facilities by approximately 60% compared to NAA. Operations at the proposed north Delta intake facilities and the NBA Alternative Intake would potentially entrain juveniles, but this would be minimized by installation of state-of-the-art fish screens and operations with an adaptive management program. There would not be an adverse effect, and the overall effect is expected to be beneficial.

**CEQA Conclusion:** As described above, operational activities associated with reduced water exports from SWP/CVP south Delta facilities under Alternative 1A would result in an overall decrease in entrainment for juvenile winter-run Chinook salmon (on average 61% decrease compared to Existing Conditions). At the same time, operational activities associated with water exports from SWP/CVP north Delta intake facilities would result in an increase in entrainment or a loss of individuals for salmon at that location. However, because the intakes would be equipped with state of the art screens, compared to the south Delta facilities, entrainment is expected to be reduced as a whole. The potential impacts of Alternative 1A water operations on entrainment of winter-run Chinook salmon would be beneficial. Consequently, no mitigation would be required.

**Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Winter-Run ESU)**

In general, Alternative 1A would reduce the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to NAA.

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were examined during the May through September winter-run spawning period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation. Flows under A1A\_LLT during May, June, and July would generally be similar to or greater than flows under NAA. Flows under A1A\_LLT during August and September would generally be lower than flows under NAA by up to 45%. These results indicate that there would be intermittent negligible to small flow-related effects of Alternative 1A on spawning and egg incubation habitat.

Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the May through September winter-run spawning and egg incubation period. May Shasta storage volume under A1A\_LLT would be similar to or up to 8% lower than storage under NAA for all water year types (Table 11-1A-10).

**Table 11-1A-10. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Alternative 1A Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-85 (-2%)	-51 (-1%)
Above Normal	-169 (-4%)	-82 (-2%)
Below Normal	-518 (-13%)	-320 (-8%)
Dry	-647 (-17%)	-202 (-6%)
Critical	-618 (-25%)	-35 (-2%)

34

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
 2 examined during the May through September winter-run spawning period (Appendix 11D,  
 3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 5 NAA and Alternative 1A in any month or water year type throughout the period at either location.

6 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
 7 determined for each month (May through September) and year of the 82-year modeling period  
 8 (Table 11-1A-11). The combination of number of days and degrees above the 56°F threshold were  
 9 further assigned a “level of concern”, as defined in Table 11-1A-12. Levels of concern were used to  
 10 examine variation in temperature results and were not meant to be biologically meaningful.  
 11 Differences between baselines and Alternative 1A in the highest level of concern across all months  
 12 and all 82 modeled years are presented in Table 11-1A-13. There would be no difference in levels of  
 13 concern between NAA and Alternative 1A.

14 **Table 11-1A-11. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon**  
 15 **Provided by NMFS and Used in the BDCP Effects Analysis**

Location	Period	Maximum Water Temperature (°F)	Purpose
<b>Upper Sacramento River</b>			
Bend Bridge	May-Sep	56	Winter- and spring-run spawning and egg incubation
		63	Green sturgeon spawning and egg incubation
Red Bluff	Oct-Apr	56	Spring-, fall-, and late fall-run spawning and egg incubation
Hamilton City	Mar-Jun	61 (optimal), 68 (lethal)	White sturgeon spawning and egg incubation
<b>Feather River</b>			
Robinson Riffle (RM 61.6)	Sep-Apr	56	Spring-run and steelhead spawning and incubation
	May-Aug	63	Spring-run and steelhead rearing
Gridley Bridge	Oct-Apr	56	Fall- and late fall-run spawning and steelhead rearing
	May-Sep	64	Green sturgeon spawning, incubation, and rearing
<b>American River</b>			
Watt Avenue Bridge	May-Oct	65	Juvenile steelhead rearing

16

1 **Table 11-1A-12. Number of Days per Month Required to Trigger Each Level of Concern for Water**  
 2 **Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided**  
 3 **by NMFS and Used in the BDCP Effects Analysis**

Exceedance above Water Temperature Threshold (°F)	Level of Concern			
	None	Yellow	Orange	Red
1	0-9 days	10-14 days	15-19 days	≥20 days
2	0-4 days	5-9 days	10-14 days	≥15 days
3	0 days	1-4 days	5-9 days	≥10 days

4

5 **Table 11-1A-13. Differences between Baseline and Alternative 1A Scenarios in the Number of**  
 6 **Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**  
 7 **Sacramento River at Bend Bridge, May through September**

Level of Concern <sup>a</sup>	EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
Red	33 (67%)	0 (0%)
Orange	-15 (-100%)	0 (NA)
Yellow	-15 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> For definitions of levels of concern, see Table 11-1A-12.

8

9 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
 10 during May through September (Table 11-1A-14). Total degree-days under Alternative 1A would be  
 11 up to 15% lower than under NAA during May and June and up to 20% higher during July through  
 12 September.

1 **Table 11-1A-14. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**  
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
May	Wet	953 (253%)	-249 (-16%)
	Above Normal	226 (106%)	-129 (-23%)
	Below Normal	453 (207%)	-10 (-1%)
	Dry	180 (97%)	-234 (-39%)
	Critical	413 (187%)	3 (0%)
	All	2,224 (183%)	-620 (-15%)
June	Wet	321 (84%)	-390 (-36%)
	Above Normal	90 (61%)	-139 (-37%)
	Below Normal	394 (283%)	42 (9%)
	Dry	570 (303%)	36 (5%)
	Critical	597 (149%)	47 (5%)
	All	1,972 (157%)	-404 (-11%)
July	Wet	760 (147%)	154 (14%)
	Above Normal	383 (473%)	113 (32%)
	Below Normal	876 (596%)	420 (70%)
	Dry	1,349 (478%)	421 (35%)
	Critical	1,845 (224%)	59 (2%)
	All	5,213 (281%)	1,167 (20%)
August	Wet	2,217 (318%)	254 (10%)
	Above Normal	933 (229%)	274 (26%)
	Below Normal	1,358 (512%)	323 (25%)
	Dry	2,236 (334%)	626 (27%)
	Critical	2,751 (185%)	132 (3%)
	All	9,494 (269%)	1,607 (14%)
September	Wet	2,398 (325%)	1,689 (117%)
	Above Normal	997 (140%)	597 (54%)
	Below Normal	1,385 (186%)	239 (13%)
	Dry	2,531 (198%)	-65 (-2%)
	Critical	1,867 (90%)	-24 (-1%)
	All	9,182 (165%)	2,437 (20%)

4

5 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
 6 Sacramento River under A1A\_LLT would be similar to mortality under NAA except in above normal,  
 7 below normal and dry water years (13% 120%, and 9% higher, respectively). The increase in the  
 8 percent of winter-run population subject to mortality would be less than 2% in all water years.  
 9 Therefore, the increase in mortality of 9% to 120% from NAA to A1A\_LLT, although relatively large,  
 10 would be negligible at an absolute scale to the winter-run population (Table 11-1A-15). These  
 11 results indicate that climate change would cause the majority of the increase in winter-run egg  
 12 mortality.

**Table 11-1A-15. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	1 (264%)	-0.1 (-4%)
Above Normal	2 (413%)	0.3 (13%)
Below Normal	3 (310%)	2 (120%)
Dry	7 (423%)	1 (9%)
Critical	43 (158%)	-2 (-2%)
All	9 (189%)	0.3 (2%)

SacEFT predicts that there would be a 28% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A1A\_LLT relative to NAA (Table 11-1A-16). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A1A\_LLT would be similar to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A1A\_LLT would be similar to that under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A1A\_LLT would be 17% lower compared to NAA. These results indicate that there would be moderate effects of Alternative 1A on spawning habitat.

**Table 11-1A-16. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Spawning WUA	-35 (-60%)	-9 (-28%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-25 (-26%)	-2 (-3%)
Redd Dewatering Risk	-1 (-4%)	-5 (-17%)
Juvenile Rearing WUA	-8 (-16%)	17 (68%)
Juvenile Stranding Risk	-15 (-75%)	-26 (-84%)

WUA = Weighted Usable Area.

**NEPA Effects:** Considering the results presented here for winter-run Chinook salmon spawning and egg incubation, this effect would be adverse because it has the potential to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. Flows during August and September would be moderately lower under Alternative 1A. In addition, the total degree-days exceeding the 56°F NMFS threshold at Bend Bridge would be 14% to 20% greater than the total under the NEPA baseline during three of the five months examined. Combining these results with those of the SacEFT model, which predicts that the number of years with good winter-run spawning habitat would be reduced by 28% and the number of years with good (low) redd dewatering risk would be 17% lower under Alternative 1A (Table 11-1A-16), the impact is adverse to winter-run Chinook salmon. This effect is a result of the specific reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby making it a different alternative

1 than that which has been modeled and analyzed. As a result, this would be an unavoidable adverse  
2 effect because there is no feasible mitigation.

3 **CEQA Conclusion:** In general, Alternative 1A would reduce the quantity and quality of spawning and  
4 egg incubation habitat for winter-run Chinook salmon relative to the Existing Conditions.

5 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined  
6 during the May through September winter-run spawning and egg incubation period (Appendix 11C,  
7 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be  
8 similar to or greater than flows under Existing Conditions during May and June and generally lower  
9 by up to 26% during July, August, and September.

10 Shasta Reservoir storage volume at the end of May under A1A\_LLT would be similar to Existing  
11 Conditions in wet and above normal water years, but 13% to 25% lower in the other below normal,  
12 dry, and critical water years (Table 11-1A-10). This indicates that there would be a small to  
13 moderate effect of Alternative 1A on flows during the spawning and egg incubation period.

14 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
15 examined during the May through September winter-run spawning period (Appendix 11D,  
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
18 Existing Conditions and Alternative 1A during May and June. Mean monthly water temperature  
19 would be up to 14% higher under Alternative 1A in July through September depending on month,  
20 water year type, and location.

21 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
22 determined for each month (May through September) and year of the 82-year modeling period  
23 (Table 11-1A-11). The combination of number of days and degrees above the 56°F threshold were  
24 further assigned a “level of concern”, as defined in Table 11-1A-12. The number of years classified as  
25 “red” would increase by 67% under Alternative 1A relative to Existing Conditions (Table 11-1A-13).

26 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
27 during May through September (Table 11-1A-14). Total degree-days under Alternative 1A would be  
28 157% to 281% higher than that under Existing Conditions depending on month throughout the  
29 period.

30 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
31 Sacramento River under A1A\_LLT would be 158 to 423% greater than mortality under Existing  
32 Conditions depending on water year type (Table 11-1A-15). These increases would only affect the  
33 winter-run population during dry and critical years, in which the absolute percent increase of the  
34 winter-run population would be 7 and 43%, respectively. These results indicate that Alternative 1A  
35 would cause increased winter-run Chinook salmon mortality in the Sacramento River.

36 SacEFT predicts that there would be a 60% decrease in the percentage of years with good spawning  
37 availability, measured as weighted usable area, under A1A\_LLT relative to Existing Conditions  
38 (Table 11-1A-16). SacEFT predicts that the percentage of years with good (lower) redd scour risk  
39 under A1A\_LLT would be similar to the percentage of years under Existing Conditions. SacEFT  
40 predicts that the percentage of years with good egg incubation conditions under A1A\_LLT would be  
41 26% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good  
42 (lower) redd dewatering risk under A1A\_LLT would be 4% lower than the percentage of years

1 under Existing Conditions. These results indicate that Alternative 1A would cause small to moderate  
2 reductions in spawning WUA and egg incubation conditions.

3 Collectively, these results indicate that the impact would be significant because it has the potential  
4 to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a  
5 result of egg mortality. Egg mortality in drier years, during which winter-run Chinook salmon would  
6 already be stressed due to reduced flows and increased temperatures, would be up to 43% greater  
7 on an absolute scale due to Alternative 1A compared to the Existing Conditions (Table 11-1A-15).  
8 Further, the extent of spawning habitat would be 60% lower due to Alternative 1A compared to the  
9 Existing Conditions (Table 11-1A-16), which represents a substantial reduction in spawning habitat  
10 and, therefore, in adult spawner and redd carrying capacity. This impact is a result of the specific  
11 reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g.,  
12 changing reservoir operations in order to alter the flows) to the extent necessary to reduce this  
13 impact to a less-than-significant level would fundamentally change the alternative, thereby making  
14 it a different alternative than that which has been modeled and analyzed. As a result, this impact is  
15 significant and unavoidable because there is no feasible mitigation available. Even so, proposed  
16 below is mitigation that has the potential to reduce the severity of impact though not necessarily to  
17 a less-than-significant level.

18 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional**  
19 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
20 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

21 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
22 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
23 the best available scientific information at the time and may prove to have been over- or  
24 understated. Upon the commencement of operations of CM1 and continuing through the life of  
25 the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine  
26 whether such effects would be as extensive as concluded at the time of preparation of this  
27 document and to determine any potentially feasible means of reducing the severity of such  
28 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
29 consistent with the operational framework for Alternative 1A.

30 The development and implementation of any mitigation actions shall be focused on those  
31 incremental effects attributable to implementation of Alternative 1A operations only.  
32 Development of mitigation actions for the incremental impact on spawning habitat attributable  
33 to climate change/sea level rise are not required because these changed conditions would occur  
34 with or without implementation of Alternative 1A.

35 **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts**  
36 **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

37 Following commencement of initial operations of CM1 and continuing through the life of the  
38 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
39 modified operations could reduce impacts to spawning habitat under Alternative 1A. The  
40 analysis required under this measure may be conducted as a part of the Adaptive Management  
41 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

1           **Mitigation Measure AQUA-40c: Consult with USFWS and CDFW to Identify and Implement**  
2           **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Spawning**  
3           **Habitat Consistent with CM1**

4           In order to determine the feasibility of reducing the effects of CM1 operations on winter-run  
5           Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of  
6           Fish and Wildlife to identify and implement any feasible operational means to minimize effects  
7           on spawning habitat. Any such action will be developed in conjunction with the ongoing  
8           monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-40a.

9           If feasible means are identified to reduce impacts on spawning habitat consistent with the  
10          overall operational framework of Alternative 1A without causing new significant adverse  
11          impacts on other covered species, such means shall be implemented. If sufficient operational  
12          flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under  
13          Alternative 1A operations, achieving further impact reduction pursuant to this mitigation  
14          measure would not be feasible under this Alternative, and the impact on winter-run Chinook  
15          salmon would remain significant and unavoidable.

16          **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
17          **(Winter-Run ESU)**

18          In general, Alternative 1A would reduce the quantity and quality of rearing habitat for fry and  
19          juvenile winter-run Chinook salmon relative to NAA.

20          Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
21          salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
22          *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing  
23          habitat. Flows under A1A\_LLT would generally be similar to or greater than flows under NAA during  
24          October and December, and generally lower during August, September, and November by up to  
25          44%.

26          Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
27          examined during the August through December winter-run juvenile rearing period (Appendix 11D,  
28          *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
29          *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
30          NAA and Alternative 1A in any month or water year type throughout the period at either location.

31          SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
32          measured as weighted usable area, under A1A\_LLT would be 68% greater than the percentage of  
33          years under NAA (Table 11-1A-16). In addition, the percentage of years with good (low) juvenile  
34          stranding risk under A1A\_LLT is predicted to 84% lower than under NAA. This indicates that, while  
35          the quantity of juvenile rearing habitat in the Sacramento River would be greater, the quality,  
36          measured as stranding risk, would be substantially reduced under A1A\_LLT relative to NAA.

37          SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A1A\_LLT would  
38          have a negligible difference (<5%) in habitat-related mortality compared with NAA.

39          **NEPA Effects:** Collectively, these results indicate that the effect is adverse because it has the  
40          potential to substantially reduce the amount of suitable habitat and substantially interfere with the  
41          movement of fish. Differences in flows, although small, are consistent among most months and  
42          water year types. In addition, effects on juvenile stranding risk are substantially negative (26%

1 absolute scale, or 84% relative scale reduction). This effect is a result of the specific reservoir  
2 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing  
3 reservoir operations in order to alter the flows) to the extent necessary to reduce this effect to a  
4 level that is not adverse would fundamentally change the alternative, thereby making it a different  
5 alternative than that which has been modeled and analyzed. As a result, this would be an  
6 unavoidable adverse effect because there is no feasible mitigation available.

7 **CEQA Conclusion:** In general, Alternative 1A would reduce the quantity and quality of fry and  
8 juvenile rearing habitat for winter-run Chinook salmon relative to the Existing Conditions.

9 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
10 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
11 *in the Fish Analysis*). Flows under A1A\_LLT would generally be similar to or greater than flows under  
12 Existing Conditions during October and December, but up to 24% lower than Existing Conditions  
13 during August, September, and November.

14 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
15 examined during the August through December winter-run rearing period (Appendix 11D,  
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
17 *Fish Analysis*). Mean monthly water temperature would be up to 14% higher under Alternative 1A in  
18 July through October depending on month, water year type, and location. There would be no  
19 differences (<5%) between Existing Conditions and Alternative 1A in mean monthly water  
20 temperature during November and December at either location.

21 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
22 measured as weighted usable area, under A1A\_LLT would be 16% lower than under Existing  
23 Conditions (Table 11-1A-16). In addition, the percentage of years with good (low) juvenile stranding  
24 risk under A1A\_LLT is predicted to be substantially (75%) lower than under Existing Conditions.  
25 This indicates that the quantity and quality of juvenile rearing habitat in the Sacramento River  
26 would be lower under A1A\_LLT relative to Existing Conditions.

27 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A1A\_LLT would  
28 be 10% higher than under Existing Conditions.

29 These results indicate that the impact would be significant because it has the potential to  
30 substantially reduce the amount of suitable habitat and substantially interfere with the movement of  
31 fish. Differences in flows are moderately large during the majority of months and water year types.  
32 Further, a 16% reduction in rearing habitat quantity and 75% increase in stranding risk would  
33 reduce upstream habitat conditions for winter-run fry and juveniles. SALMOD predicts a 10%  
34 increase in habitat-related mortality of winter-run smolt equivalents under Alternative 1A. This  
35 impact is a result of the specific reservoir operations and resulting flows associated with this  
36 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
37 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
38 change the alternative, thereby making it a different alternative than that which has been modeled  
39 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
40 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
41 severity of impact though not necessarily to a less-than-significant level.

1 **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**  
2 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
3 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

4 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
5 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
6 best available scientific information at the time and may prove to have been over- or  
7 understated. Upon the commencement of operations of CM1 and continuing through the life of  
8 the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine  
9 whether such effects would be as extensive as concluded at the time of preparation of this  
10 document and to determine any potentially feasible means of reducing the severity of such  
11 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
12 consistent with the operational framework for Alternative 1A.

13 The development and implementation of any mitigation actions shall be focused on those  
14 incremental effects attributable to implementation of Alternative 1A operations only.  
15 Development of mitigation actions for the incremental impact on rearing habitat attributable to  
16 climate change/sea level rise compared to Existing Conditions are not required because these  
17 changed conditions would occur with or without implementation of Alternative 1A.

18 **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**  
19 **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

20 Following commencement of initial operations of CM1 and continuing through the life of the  
21 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
22 modified operations could reduce impacts to rearing habitat under Alternative 1A. The analysis  
23 required under this measure may be conducted as a part of the Adaptive Management and  
24 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25 **Mitigation Measure AQUA-41c: Consult with USFWS and CDFW to Identify and Implement**  
26 **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Rearing**  
27 **Habitat Consistent with CM1**

28 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run  
29 Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of  
30 Fish and Wildlife to identify and implement any feasible operational means to minimize effects  
31 on rearing habitat. Any such action will be developed in conjunction with the ongoing  
32 monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-41a.

33 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
34 operational framework of Alternative 1A without causing new significant adverse impacts on  
35 other covered species, such means shall be implemented. If sufficient operational flexibility to  
36 reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 1A  
37 operations, achieving further impact reduction pursuant to this mitigation measure would not  
38 be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain  
39 significant and unavoidable.

1 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
2 **(Winter-Run ESU)**

3 In general, Alternative 1A would affect migration conditions for winter-run Chinook salmon relative  
4 to NAA.

5 **Upstream of the Delta**

6 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November  
7 juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). A  
8 reduction in flow may reduce the ability of juvenile winter-run Chinook salmon to migrate  
9 effectively down the Sacramento River. Flows under A1A\_LLT would generally be similar or up to  
10 36% greater to flows under NAA in July and October, and generally lower than NAA flows during  
11 August, September, and November, in which flows would be up to 44% lower under A1A\_LLT.

12 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
13 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
16 NAA and Alternative 1A in any month or water year type throughout the period at either location.

17 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run  
18 Chinook salmon upstream migration period (December through August). A reduction in flows may  
19 reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the  
20 upper Sacramento River. Flows under A1A\_LLT would generally be similar to or greater than those  
21 under NAA except during August, in which flows would be up to 19% lower under A1A\_LLT.

22 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
23 examined during the December through August winter-run upstream migration period (Appendix  
24 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
25 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
26 between NAA and Alternative 1A in any month or water year type throughout the period at either  
27 location.

28 **Through-Delta**

29 ***Juveniles***

30 The effects of Alternative 1A on juvenile winter-run Chinook salmon were evaluated by examining  
31 changes in flows downstream of the north Delta diversion, estimated predation losses associated  
32 with these intakes, and modeled survival by the Delta Passage Model.

33 ***Sacramento River flows***

34 As discussed in the *BDCP Effects Analysis – Appendix 5.C Flow (Section 5.5.3.2)*, Plan Area flows have  
35 considerable importance for downstream migrating juvenile salmonids, as shown by studies in  
36 which through-Delta survival of Chinook salmon smolts positively correlated with flow (Newman  
37 2003; Perry et al. 2010), although Zeug and Cavallo (2012) did not find evidence for effects of inflow  
38 on the probability of recovery of coded-wire-tagged Chinook salmon in ocean fisheries. Flow-related  
39 survival, in terms of the influence of downstream river (net) flow, may be more important in areas  
40 with largely unidirectional downstream flow as opposed to strong tidal influence, for tidal influence

1 progressively becomes much greater with movement downstream (see *BDCP Effects Analysis –*  
 2 *Appendix 5.C, Flow, Passage, Salinity, and Turbidity, Section 5.C.5.3.1.11.1* for discussion of context of  
 3 flow changes). The Delta Passage Model (DPM), for example, does not include a net flow-survival  
 4 relationship in the Sacramento River below Rio Vista because such a relationship is not supported  
 5 by existing data (*BDCP Effects Analysis – Appendix 5.C, Section 5.C.4.3.2.2*). Dispersal of smaller,  
 6 fry-sized Chinook salmon that may forage and rear in the Plan Area for longer periods of time is also  
 7 related to flows upstream and within the Plan Area (Kjelson et al. 1982; Brandes and McLain 2001).  
 8 Foraging winter-run Chinook salmon spend longer periods of time within the Plan Area and may not  
 9 be as reliant on Plan Area channel flows for migration.

10 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows  
 11 below the north Delta intakes compared to Existing Conditions. Mean monthly flows were simulated  
 12 by CALSIM-II during the winter-run Chinook emigration period (November to early May). Under  
 13 Alternative 1A, monthly flows averaged across all water years were approximately 10% to 31%  
 14 lower compared to baseline conditions. The differences by water year types ranged from fairly  
 15 similar to baseline conditions (about 5% difference) in December of dry and critical years, to 39%  
 16 lower in November of above normal years.

17 It is important to emphasize that *CM1 Water Facilities and Operation* includes bypass flow criteria  
 18 that will be managed in real time to minimize adverse effects of diversions at the north Delta intakes  
 19 on downstream-migrating salmonids. Juvenile salmonids migrating down the Sacramento River  
 20 often do so in pulses that are triggered by increases in flows. CM1 will account for such changes in  
 21 flows and the associated pulses of fish by monitoring fish presence at locations such as Knights  
 22 Landing and adjusting to low-level pumping as necessary. Low-level pumping will consist of total  
 23 north Delta diversions of up to 6% of river flow for flows greater than 5,000 cfs and not more than  
 24 300 cfs at any intake. Following the initial pulse flows, schedules of post-pulse flows will be applied  
 25 depending on flows in the river at the time. Additional detail is provided in Chapter 3 Section 3.6.4.2.

#### 26 *Predation Associated with North Delta Diversion Intakes*

27 The north Delta export facilities would likely attract piscivorous fish around the intake structures.  
 28 Predation losses were estimated by two methods to bound the hypothetical range of potential  
 29 mortality: striped bass bioenergetics modeling of salmon predation, and an assumed 5% fixed rate  
 30 of loss of juvenile salmon migrating past the overall facilities. These two methods provide a  
 31 hypothetical range of potential mortality at the north Delta diversion, with uncertainties associated  
 32 with each estimate. Neither method takes into account existing levels of predation along the  
 33 channelized Sacramento River channel.

34 The bioenergetics model estimated striped bass annual consumption of migrating juvenile salmon at  
 35 the north Delta intakes. The methods (based on Loboschefskey and Nobriga 2010, Loboschefskey et al.  
 36 2012) are detailed in *BDCP 5F – Biological Stressors (Section 5F.3.1, hereby incorporated by*  
 37 *reference)*. Consumption estimates were based on water temperature, striped bass size and density,  
 38 and the density and size of prey encountered. Striped bass densities were based on observations at  
 39 the Glenn Colusa Irrigation District (GCID) facility on the upper Sacramento River (Vogel\_2008). At a  
 40 median predator density of 0.12 predators per foot (0.39 predators per meter) of intake, estimated  
 41 predation loss would represent about 2% of the annual production of juvenile winter-run Chinook  
 42 salmon (Table 11-1A-17). The bioenergetics model likely overestimates predation of juvenile  
 43 salmon because of simplified model assumptions.

**Table 11-1A-17. Chinook Salmon Predation Loss at the Proposed North Delta Intake Facilities (Five Intakes)**

Striped Bass Numbers		Estimated Number of Juvenile Salmon Consumed				Percentage of Annual Juvenile Production (%) Consumed			
Per 1,000 ft of Intake	Total Bass	Winter	Spring	Fall	Late Fall	Winter	Spring	Fall	Late Fall
18 (Low)	154	7,815	10,935	167,668	31,724	0.3	0.3	0.3	0.7
119 (Median)	1,017	51,669	72,292	1,108,470	209,734	2.0	1.7	1.8	4.9
219 (High)	1,872	95,087	133,042	2,039,958	385,981	3.7	3.2	3.3	9.0

Source: *BDCP Effects Analysis – Appendix 5.F Biological Stressors, Section 5F.5.3.1.1.*

Note: Based on bioenergetics modeling of consumption by striped bass.

A conservative upper estimate of potential predation assumed a fixed 5% loss per intake due to predation as well as impingement, injury or exhaustion (described in *BDCP Effects Analysis – Appendix 5.F, Biological Stressors on Covered Fish, Section 5F.3.2.2*) and habitat loss associated with screened intakes. This 5% loss was applied iteratively for the five successive intakes on the Sacramento River under Alternative 1A. The assumed 5% loss term is based on observations of acoustically tagged hatchery-raised juvenile salmon released at the GCID diversion facilities (Vogel 2008). There is considerable uncertainty in applying this loss term to the north Delta diversions because the design and location of the GCID screen and the north Delta diversion are substantially different. The GCID is located along a relatively narrow oxbow channel (about 10 to 50 meters wide) while the north Delta intakes would be located on the much wider channel of the mainstem lower Sacramento River (about 150 to 180 meters wide). For the purposes of this analysis, it is assumed that all juvenile salmon migrating down the mainstem Sacramento River would come in close proximity to the intakes, although there is high uncertainty with this assumption. However, the estimates of predation loss at GCID are for a single large diversion intake, while Alternative 1A would have five north Delta intakes. Thus, while factors unique to the GCID screen may increase predation loss estimates relative to the north Delta, the cumulative amount of intake structure proposed under the Plan would be much larger than the GCID screen, increasing exposure of juvenile salmon to screen-related impacts.

The 5% loss would apply only to those fish that pass through this reach close to the screens, although the assumption here is that all the fish passing are subject to this 5% loss. Of the Sacramento Basin population of Chinook salmon smolts that reach the Delta, a small proportion would be expected to emigrate through the Yolo Bypass and downstream to Rio Vista, thus bypassing the north Delta intakes entirely (*BDCP Effects Analysis – Appendix 5.C, Flow, Passage, Salinity, and Turbidity*). The average proportion of Chinook salmon smolts modeled by DPM entering the Yolo Bypass was 12.1% for winter-run, 8.8% for spring-run, and 3.4% for fall-run and 3.6% for late fall-run. The remainder of smolts would outmigrate via the mainstem Sacramento River past the proposed north Delta intakes. The proportion of migrating smolts surviving to the north Delta intakes, as estimated by the DPM, would be 93.1% of winter-run salmon smolts, 93.1% of spring-run salmon smolts, 93.2% of Sacramento River basin fall-run salmon smolts, and 93.0% of late fall-run salmon smolts. Under the fixed loss method, the cumulative attrition across the five intakes of the north Delta diversion complex for Alternative 1A would be an estimated 18.5% loss of those smolts that reached the north Delta. However, there are appreciable uncertainties in these analyses,

1 including unknown baseline levels of predation, uncertainty in the bioenergetics model parameters,  
2 and the comparability of the GCID intakes.

3 *Habitat Loss Associated with North Delta Diversion Intakes*

4 Juvenile salmon utilize shoreline areas to feed and grow during their out-migration. Shoreline  
5 features that include natural cover such as submerged and overhanging large wood, aquatic  
6 vegetation, and undercut banks provide greater habitat complexity for foraging, resting, and  
7 avoiding predators. As juvenile Chinook salmon grow, they move into deeper water with higher  
8 current velocities, but still seek shelter and velocity refugia to minimize energy expenditures.  
9 (Healey 1991, Moyle 2002).

10 While the condition of the habitat at the intake sites has been altered with riprap and has limited in-  
11 water or overwater habitat features typically associated with fish rearing and out-migration habitat,  
12 it nevertheless provides some level of cover/shade, refuge, and organic input of value to out-  
13 migrating salmonids. The in-water components of the intake structures would permanently alter the  
14 condition of migratory habitats in the vicinity of the intake locations. The mainstem Sacramento  
15 River is designated as critical habitat for all listed runs of Chinook salmon, providing important  
16 habitat for migration. Approximately 22 acres of in-water habitat and 11,900 linear feet of shoreline  
17 habitat would be permanently modified and/or inaccessible as a result of the intakes. While  
18 restoration components of the BDCP (CM4–CM7 in particular) would provide substantial habitat  
19 values, the permanent loss of 22 acres under Alternative 1A would adversely affect migratory  
20 conditions.

21 *Delta Passage Model*

22 Through-Delta survival to Chipps Island by emigrating winter-run Chinook smolts was modeled by  
23 the Delta Passage Model (DPM). The DPM simulates migration and mortality of Chinook salmon  
24 smolts entering the Delta from the Sacramento, Mokelumne, and San Joaquin Rivers through a  
25 simplified Delta channel network, and provides quantitative estimates of relative Chinook salmon  
26 smolt survival through the Delta to Chipps Island (method detailed in *BDCP 5C Flow, Passage,*  
27 *Salinity and Turbidity, Section 5C.4.3.2.2 hereby incorporated by reference*). The DPM does not account  
28 for habitat restoration.

29 Average survival under Alternative 1A would be 33% across all years, 45% in wetter years, and 26%  
30 in drier years (Table 11-1A-18). Modeled survival would be similar (<5% difference) to baseline  
31 conditions (about 1% lower survival compared to NAA, a 1% to 4% relative decrease).

1 **Table 11-1A-18. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**  
2 **under Alternative 1A**

Year Types	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A1A_LLТ	EXISTING CONDITIONS vs. A1A_LLТ	NAA vs. A1A_LLТ
Wetter Years	46.3	46.1	45.5	-0.9 (-2%)	-0.6 (-1%)
Drier Years	28.0	27.1	26.0	-2.0 (-6%)	-1.1 (-4%)
All Years	34.9	34.2	33.3	-1.6 (-5%)	-0.9 (-3%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

### Adults

Attraction flows and the importance of olfactory cues to adult Chinook salmon were well-described by Marston et al. (2012): Chinook salmon rely primarily on olfactory cues to successfully migrate through the Delta’s maze of waterways to home back to their natal river (Groves et al. 1968; Mesick 2001). Juvenile salmon imprint by acquiring a series of chemical waypoints at every major confluence that enables them to relocate their river of origin (Quinn 1997; Williams 2006).

Marston et al. (2012) used recoveries of coded-wire tags from hatchery-origin Chinook salmon to estimate stray rates of adults. Fish released further upstream in-river had considerably lower straying rates than fish released downstream (including in San Francisco Bay) presumably because the fish released downstream had imprinted on fewer waypoints. For the Sacramento River, the stray rate for fish released upstream of the confluence of the Sacramento and San Joaquin Rivers was very low (average 0.1%, range 0 to 6.7%; Marston et al. 2012)—if this rate is representative of wild populations spawned upstream, then it indicates a very low rate of straying for fish emigrating from natal tributaries in the Sacramento River basin with the existing flows through the Plan Area. As noted by Marston et al. (2012:18), Quinn (1997) suggested that background levels of straying for hatchery-origin salmon are 2% to 5%, although few studies have been conducted on wild-origin Chinook salmon; one such study for wild-origin Mokelumne River Chinook salmon—albeit a population with appreciable hatchery influence—reported a stray rate of over 7% (Williams 2006 as cited in Marston et al. 2006). Therefore, for this analysis of effects, it was assumed with high certainty that Plan Area migration flows for adult winter-run Chinook salmon (incorporating factors such as olfactory cues) are of low importance as an attribute that has been changed from its historical condition, as judged by the low stray rate of Sacramento-origin hatchery fish. The high certainty level reflects the low levels of straying reported for adult Chinook salmon from the Sacramento River region under existing flow conditions.

Sacramento River flows downstream of the proposed north Delta intakes generally will be lower under Alternative 1A operations relative to baseline (NAA), with differences between water-year types because of differences in the relative proportion of water being exported from the north Delta and south Delta facilities (*Appendix 11C*). The effects of flow reduction in the lower reach of the Sacramento River on the attraction and upstream migration of adult salmonids are uncertain. Flows in the lower Sacramento River are influenced by tidal hydrodynamics (as discussed in *Appendix 5.C*,

1 *Flow, Passage, Salinity, and Turbidity, Section 5C.5.3.1.11.1 Changes in Tidally Influenced Areas of the*  
2 *Plan Area (Delta Region)).* The influence of the tide may also affect adult attraction and migration.

3 The average percentage of Sacramento River–origin water at Collinsville, where the Sacramento and  
4 San Joaquin Rivers converge in the West Delta subregion, was assessed by DSM2 fingerprinting  
5 analysis (detailed in *BDCP 5C.4 Flow, Passage, Salinity and Turbidity, Section 5C.4.3.1 hereby*  
6 *incorporated by reference*). For migrating adult winter-run Chinook (December-February migration  
7 period) this proportion would be slightly lower (3% to 6% decrease) under Alternative 1A  
8 (averages 63% to 71%) compared to NAA (averages 66% to 75%) (Table 11-1A-19). While the  
9 importance of olfactory cues for guiding adult salmonids to upstream spawning habitat is well-  
10 recognized (Hasler and Scholz 1983; Quinn 2005; review by Marston et al. 2012), detection and  
11 response to flow changes can vary. For example, adult sockeye salmon detected and behaviorally  
12 responded to a change in olfactory cues (e.g., dilution of olfactory cues from their natal stream) of  
13 greater than approximately 20%, although adults were not discernibly affected by dilution of 10%  
14 or less (Fretwell 1989). This may indicate that flow differences estimated for winter-run Chinook  
15 salmon under Alternative 1A will not be of considerable importance, although this is uncertain.

16 **Table 11-1A-19. Monthly Average Percentage (%) of Water at Collinsville Originating in the**  
17 **Sacramento River during the December through February Adult Winter-Run Chinook Salmon**  
18 **Migration Period**

Month	Percentage of Water			Difference in Percentage of Water	
	EXISTING CONDITIONS	NAA	A1A_LL1	EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
December	67	66	63	-4	-3
January	76	75	71	-5	-4
February	75	73	67	-8	-6

Source: DSM2-QUAL fingerprinting analysis (monthly time step, October 1976-September 1991). *BDCP Effects Analysis – Appendix 5.5, Section 5C.5.3. Passage, Movement, and Migration Results.*

19  
20 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 1A is adverse because it has  
21 the potential to substantially decrease winter-run Chinook salmon migration habitat conditions in  
22 the Sacramento River. In addition, this alternative is adverse due to the cumulative effects  
23 associated with five north Delta intake facilities, including mortality related to near-field effects (e.g.  
24 impingement and predation) and far-field effects (reduced survival due to reduced flows  
25 downstream of the intakes) associated with the five NDD intakes.

26 Upstream of the Delta in the Sacramento River, flows would be up to 44% lower during the majority  
27 of the juvenile migration period. These reductions in flow may impact the condition and survival of  
28 juvenile winter-run Chinook salmon as they migrate downstream. There would be no effect of  
29 Alternative 1A on upstream flows during the adult migration period or on temperatures during  
30 either migration period.

31 Adult attraction flows in the Delta under Alternative 1A would be lower than those under NAA, but  
32 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

33 Near-field effects of Alternative 1A NDD on winter-run Chinook salmon related to impingement and  
34 predation associated with five new intakes could result in substantial effects on juvenile migrating  
35 winter-run Chinook salmon, although there is high uncertainty regarding the potential effects.

1 Estimates within the effects analysis range from very low levels of effects (<2% mortality) to very  
2 significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented  
3 with the intent of providing localized and temporary reductions in predation pressure at the NDD.  
4 Additionally, several pre-construction surveys to better understand how to minimize losses  
5 associated with the five new intake structures will be implemented as part of the final NDD screen  
6 design effort. Alternative 1A also includes an Adaptive Management Program and Real-Time  
7 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
8 adequate migration conditions for winter-run Chinook salmon. However, at this time, due to the  
9 absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of  
10 mortality expected from near-field effects at the NDD remains highly uncertain.

11 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
12 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
13 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 1A  
14 predict improvements in smolt condition and survival associated with increased access to the Yolo  
15 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
16 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
17 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

18 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
19 all of these elements of BDCP operations and conservation measures to predict smolt migration  
20 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
21 migration survival under Alternative 1A would be similar to survival rates estimated for NAA.  
22 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
23 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
24 future. These efforts are expected to improve our understanding of the relationships and  
25 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
26 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
27 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
28 1A on winter-run Chinook salmon through-Delta survival remains uncertain.

29 Therefore, primarily as a result of reduced upstream migration habitat conditions for winter-run  
30 Chinook salmon due to reduced flows along with unacceptable levels of uncertainty regarding the  
31 cumulative impacts of near-field and far-field effects associated with the presence and operation of  
32 the five intakes on winter-run Chinook salmon, this effect is adverse. While implementation of the  
33 conservation and mitigation measures listed below would address these impacts, these are not  
34 anticipated to reduce the impacts to a level considered not adverse.

### 35 ***CEQA Conclusion:***

#### 36 **Upstream of the Delta**

37 In general, Alternative 1A would affect migration conditions for winter-run Chinook salmon relative  
38 to the Existing Conditions.

39 Flows in the Sacramento River upstream of Red Bluff were examined during the July through  
40 November juvenile emigration period. Flows under A1A\_LL1 for juvenile migrants would generally  
41 be lower than flows under Existing Conditions (by up to 24%), except during October, in which  
42 flows would be up to 36% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
43 *Analysis*).

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
2 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). Mean monthly water temperature would be up to 14% higher under Alternative 1A in  
5 July through October depending on month, water year type, and location. There would be no  
6 differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative  
7 1A during November.

8 Flows under A1A\_LLT in the Sacramento River upstream of Red Bluff during December through  
9 August would generally be similar or greater to flows under Existing Conditions, except during July  
10 and August, in which flows under A1A\_LLT would be up to 24% lower.

11 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
12 examined during the December through August winter-run upstream migration period (Appendix  
13 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
14 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
15 between Existing Conditions and Alternative 1A during December through June. Mean monthly  
16 water temperature would be up to 14% higher under Alternative 1A in July and August depending  
17 on month, water year type, and location.

## 18 **Through-Delta**

### 19 ***Juveniles***

20 As described above, the five NDD intakes would impact migrating juveniles due to predation at the  
21 intakes (estimated 2% to 18.5% loss of smolts entering the Delta) and lost or modified aquatic and  
22 shoreline habitat. Flows below the NDD would be reduced during juvenile and adult migration  
23 periods. Juvenile survival through the Delta, estimated by DPM, would be 33% across all years, 45%  
24 in wetter years, and 26% in drier years (Table 11-1A-18). Modeled survival would decrease slightly  
25 compared to Existing Conditions (1% to 2% lower survival, a 2% to 7% relative decrease).

### 26 ***Adults***

27 The proportion of Sacramento River water in the Delta would decline by 4% to 8% compared to  
28 Existing Conditions during the adult migration period (Table 11-1A-19), but this reduction would  
29 not be expected to significantly affect olfactory cues. Sacramento River flow at Rio Vista would  
30 generally decline during the adult migration period (*Appendix 11C*).

## 31 **Summary of CEQA Conclusion**

32 Overall, upstream of the Delta, Alternative 1A would significantly affect the migration conditions for  
33 winter-run Chinook salmon, relative to the Existing Conditions. Flows in the upper Sacramento  
34 River under Alternative 1A would be substantially lower than under Existing Conditions during the  
35 majority of the juvenile winter-run Chinook salmon migration period, although flows would  
36 generally be similar to or higher than flow under Existing Conditions during the majority of the adult  
37 migration period. In addition, water temperatures are predicted to be up to 14% greater under  
38 Alternative 1A relative to Existing Conditions during the majority of the juvenile migration period,  
39 although temperatures would not be affected during the majority of the adult migration period.  
40 Modeled juvenile survival through the Delta is expected to be similar or slightly lower in all water  
41 year types, but estimated predation losses past the five intakes could hypothetically range from 2%

1 to 19% which is significant. Additionally, habitat losses associated with five NDD structures would  
2 be significant. As a result of these changes in migration conditions, this impact is significant.

3 With respect to the NDD intakes, implementation of CM6 and CM15 would address these impacts,  
4 but are not anticipated to reduce them to a level considered less than significant. Although  
5 implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which  
6 would be lost, it would not necessarily be located near the intakes and therefore would not fully  
7 compensate for the lost habitat. Additionally, implementation of this measure would not fully  
8 address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has  
9 substantial uncertainties associated with its effectiveness such that it is considered to have no  
10 demonstrable effect. Conservation measures that address habitat and predation losses, therefore,  
11 would potentially minimize impacts to some extent but not to a less than significant level.  
12 Consequently, as a result of these changes in migration conditions, this impact is significant and  
13 unavoidable.

14 Applicable conservation measures are briefly described below and full descriptions are found in  
15 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
16 Reduction of Predatory Fishes (Predator Control) (CM15).

17 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
18 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
19 habitats on the waterside side of levees along channels that provide rearing and outmigration  
20 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
21 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
22 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
23 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
24 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
25 margin enhancement would be performed only along channels that provide rearing and  
26 outmigration habitat for juvenile salmonids. These include channels that are protected by  
27 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
28 among several others.

29 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
30 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
31 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
32 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
33 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
34 Therefore, this conservation measure is not intended to entirely remove predators at any  
35 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
36 conservation measure would also not remove piscivorous birds. Because of uncertainties  
37 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
38 projects and research actions coupled with an adaptive management and monitoring program to  
39 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
40 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
41 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

42 This impact is a result of the specific reservoir operations and resulting flows associated with this  
43 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
44 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
45 change the alternative, thereby making it a different alternative than that which has been modeled

1 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
2 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
3 severity of the impact though not necessarily to a less-than-significant level.

4 **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**  
5 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
6 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

7 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
8 significant and unavoidable adverse effects on migration habitat, this conclusion was based on  
9 the best available scientific information at the time and may prove to have been over- or  
10 understated. Upon the commencement of operations of CM1 and continuing through the life of  
11 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
12 whether such effects would be as extensive as concluded at the time of preparation of this  
13 document and to determine any potentially feasible means of reducing the severity of such  
14 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
15 consistent with the operational framework for Alternative 1A.

16 The development and implementation of any mitigation actions shall be focused on those  
17 incremental effects attributable to implementation of Alternative 1A operations only.  
18 Development of mitigation actions for the incremental impact on migration habitat attributable  
19 to climate change/sea level rise are not required because these changed conditions would occur  
20 with or without implementation of Alternative 1A.

21 **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**  
22 **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

23 Following commencement of initial operations of CM1 and continuing through the life of the  
24 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
25 modified operations could reduce impacts to migration habitat under Alternative 1A. The  
26 analysis required under this measure may be conducted as a part of the Adaptive Management  
27 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

28 **Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement**  
29 **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration**  
30 **Conditions Consistent with CM1**

31 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run  
32 Chinook salmon habitat, the BDCP proponents will consult with FWS and the Department of Fish  
33 and Wildlife to identify and implement any feasible operational means to minimize effects on  
34 migration habitat. Any such action will be developed in conjunction with the ongoing monitoring  
35 and evaluation of habitat conditions required by Mitigation Measure AQUA-42a.

36 If feasible means are identified to reduce impacts on migration habitat consistent with the  
37 overall operational framework of Alternative 1A without causing new significant adverse  
38 impacts on other covered species, such means shall be implemented. If sufficient operational  
39 flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under  
40 Alternative 1A operations, achieving further impact reduction pursuant to this mitigation  
41 measure would not be feasible under this Alternative, and the impact on winter-run Chinook  
42 salmon would remain significant and unavoidable.

1 **Restoration Measures (CM2, CM4–7, and CM10)**

2 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
3 **(Winter-Run ESU)**

4 Restoration activities are described above under delta smelt (Impact AQUA-7). Potential effects of  
5 construction activities during habitat restoration actions on Chinook salmon would be similar to  
6 those discussed above for construction and maintenance actions on Chinook salmon (see Impact  
7 AQUA-37 and Impact AQUA-38 for winter-run Chinook salmon). Because these activities would be of  
8 relatively short duration, the effects would be temporary; in addition, the activities would occur in  
9 isolated areas.

10 ***Temporary Increases in Turbidity***

11 Restoration construction activities such as riprap removal, shoreline excavation and recontouring,  
12 and planting riparian vegetation have the potential to result in temporary increases in turbidity  
13 conditions in adjacent waterways. However, implementing the environmental commitments  
14 described in Appendix 3B, *Environmental Commitments*, would minimize the potential for turbidity  
15 to affect Chinook salmon. These environmental commitments include *Environmental Training*;  
16 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
17 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; *Disposal of Spoils,*  
18 *Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*. Pertinent details of  
19 these plans are provided under Impact AQUA-1 for delta smelt.

20 ***Increased Exposure to Methylmercury***

21 As discussed above for delta smelt (Impact AQUA-8), the implementation of *CM12 Methylmercury*  
22 *Management* would minimize potential effects of methylmercury mobilization from restoration  
23 sites, on Chinook salmon. As a result, restoration activities are not expected to substantially increase  
24 the bioavailability and toxicity of methylmercury on Chinook salmon.

25 ***Accidental Spills***

26 As discussed above for construction and maintenance activities (see Impact AQUA-37 and Impact  
27 AQUA-38 for winter-run Chinook salmon), implementation of environmental commitments  
28 described in Appendix 3B, *Environmental Commitments*, would minimize the potential for  
29 introduction of contaminants to surface waters and provide for effective containment and cleanup  
30 should accidental spills occur. These environmental commitments are *Environmental Training*;  
31 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
32 *Management Plan*; and *Spill Prevention, Containment, and Countermeasure Plan*. Pertinent details of  
33 these plans are provided under Impact AQUA-1 for delta smelt.

34 ***Disturbance of Contaminated Sediments***

35 Potential effects of restoration activities on the disturbance of contaminated sediments would be  
36 similar to those discussed for delta smelt (see Impact AQUA-7). The potential impacts of toxics on  
37 Chinook salmon would be minimized to the extent possible by timing construction activities so that  
38 vulnerable juveniles are not present, and implementation of environmental commitments (see  
39 Appendix 3B, *Environmental Commitments*). These environmental commitments are *Environmental*  
40 *Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Disposal of Spoils*,

1 *Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.* Pertinent details of  
2 these plans are provided under Impact AQUA-1 for delta smelt.

### 3 ***In-Water Work Activities***

4 Potential effects of in-water restoration activities are similar to those described above for delta  
5 smelt (see Impact AQUA-7). Such activities are not expected to elevate underwater noise above the  
6 threshold sound pressure levels established for fish, and any changes in noise and light levels would  
7 be minor and temporary, and any Chinook salmon in the area would likely avoid areas where the  
8 restoration activities are occurring. Potential effects of in-water activity would be minimized by  
9 implementing the environmental commitments described under Impact AQUA-1 and in Appendix  
10 3B, *Environmental Commitments*, including *Erosion and Sediment Control Plan; Dispose of Spoils,*  
11 *Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*

### 12 ***Predation***

13 Restoration activities would be unlikely to have any measurable effect on Chinook salmon predation  
14 rates. Much of the restoration would occur on dry land (e.g., recontouring, removing levees) which  
15 would have no in-water effects including on predators. In-water activities may include the use of  
16 barges and other watercraft that could theoretically provide cover, shelter, and perching areas for  
17 Chinook salmon predators. However, the limited duration of these activities and the associated  
18 noise and disturbance would be expected to dissuade predators from concentrating at sufficient  
19 density to measurably affect predation rates on Chinook salmon.

### 20 ***Summary***

21 Restoration activities are described above under delta smelt (Impact AQUA-7). Potential effects of  
22 these activities would be similar to those discussed above for construction and maintenance actions  
23 on Chinook salmon (see Impact AQUA-37 and Impact AQUA-38 for winter-run Chinook salmon).  
24 Because these activities would be of relatively short duration, the effects would be temporary; in  
25 addition, the activities would occur in isolated areas. Implementation of the environmental  
26 commitments described in Appendix 3B, *Environmental Commitments*, that would minimize or  
27 eliminate effects on winter-run Chinook salmon include *Environmental Training; Stormwater*  
28 *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*  
29 *Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel*  
30 *Material, and Dredged Material.* Pertinent details of these plans are provided under Impact AQUA-1  
31 for delta smelt. As a result, the effects of short-term restoration construction activities are not  
32 adverse to Chinook salmon.

33 While implementation of these environmental commitments would minimize or eliminate short-  
34 term effects occurring during restoration construction, long-term effects could also occur. For  
35 example, removing or breaching levees would result in the expansion of floodplain habitat, although  
36 more frequent inundation these areas could promote conversion of mercury to methylated mercury,  
37 and runoff containing agricultural-related toxins such as copper and organochlorine pesticides.  
38 However, the overall effect of increased bioavailability of methylmercury and other pollutants on  
39 Chinook salmon is likely to be of low magnitude, periodic and localized because they would occur  
40 primarily in relation to specific actions at specific locations and would dissipate after the initial  
41 influx. In addition, *CM12 Methylmercury Management* provides for site-specific assessment of  
42 restoration areas, integration of design measures to minimize methylmercury production, and site  
43 monitoring and reporting.

1 **NEPA Effects:** With implementation of *CM12 Methylmercury Management*, the overall long-term  
2 effects of habitat restoration are expected to be beneficial to winter-run Chinook salmon and other  
3 covered fish species by providing additional or improved habitat.

4 **CEQA Conclusion:** Habitat restoration activities could result in short-term adverse effects on  
5 Chinook salmon, primarily as a result of increased turbidity and potential for contaminated  
6 sediments to enter the water column. In addition to in-water work window restrictions, the limited  
7 frequency, duration, and spatial extent of restoration construction activities would minimize these  
8 potential effects on winter-run Chinook salmon. In contrast, habitat restoration is expected to result  
9 in a significant net-benefit for Chinook salmon by substantially increasing the quality and quantity of  
10 key habitats required by this species. Implementation of environmental commitments identified  
11 above and described in detail under Impact AQUA-1 for delta smelt and in Appendix 3B,  
12 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
13 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
14 *Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and*  
15 *Dredged Material)*, along with *CM12 Methylmercury Management* to minimize methylmercury  
16 production would also reduce the frequency, duration, and spatial extent of any impacts. Therefore,  
17 this impact is considered less than significant for Chinook salmon because it would not substantially  
18 reduce habitat, restrict its range or interfere with its movement. Additionally, there would be  
19 additional beneficial long-term net benefits of habitat restoration. Consequently, no mitigation  
20 would be required.

21 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
22 **Salmon (Winter-Run ESU)**

23 Alternative 1A habitat restoration actions (particularly *CM2, Yolo Bypass Fisheries Enhancement;*  
24 *CM4, Tidal Natural Communities Restoration; CM5, Seasonally Inundated Floodplain Restoration; CM6*  
25 *Channel Margin Enhancement; and CM7 Riparian Natural Community Restoration*) could result in the  
26 disturbance or mobilization of upland and aquatic contaminants that could affect Chinook salmon  
27 (e.g., by causing embryonic deformities or bioaccumulation). As previously mentioned, a complete  
28 analysis can be found in the *BDCP Effects Analysis – Appendix 5D, Contaminants (hereby incorporated*  
29 *by reference)*. Potential impacts on winter-run Chinook salmon from effects of methylmercury,  
30 selenium, copper, ammonia, and pesticides associated with habitat restoration activities would be  
31 similar to those discussed for delta smelt (see Impact AQUA-8). The Yolo Bypass, a notable rearing  
32 area for juvenile Chinook salmon, is an area expected to be among the highest for potential  
33 methylmercury production. While juvenile Chinook salmon show high spatial variability in the  
34 bioaccumulation of methylmercury (Henery et al. 2010), it has not been demonstrated that these  
35 accumulations impair small fishes. Future exposure levels in restored habitats that are similar to  
36 current levels may not affect the species' viability, though they may be of concern for passing  
37 mercury up the food web to birds and humans. As described in *BDCP Effects Analysis – Appendix D,*  
38 *Contaminants, Section 5D.4.1 Mercury (hereby incorporated by reference)*, the amounts of  
39 methylmercury mobilized and resultant effects on covered fish species are not currently  
40 quantifiable.

41 It is anticipated that any potential effects of methylmercury on Chinook salmon will be addressed  
42 through implementation of *CM12*. *CM12* is intended to minimize methylmercury exposure  
43 associated with restoration measures for juvenile Chinook salmon. Additional analysis and tools  
44 may be developed to further reduce methylmercury exposure as the habitat restoration  
45 conservation measures are refined and analyzed in site-specific documents. The site-specific

1 analysis is the appropriate place to assess the potential for risk of methylmercury exposure for  
2 Chinook salmon once site specific sampling and other information can be developed.

3 **NEPA Effects:** The effect of restoration measures on chemical contaminants is not adverse to  
4 Chinook salmon with respect to selenium, copper, ammonia and pesticides. The effects of  
5 methylmercury on Chinook salmon are uncertain.

6 **CEQA Conclusion:** Alternative 1A restoration actions associated with CM2, CM4–CM7, and CM10, are  
7 likely to result in increased production, mobilization, and bioavailability of methylmercury,  
8 However, implementation of *CM12 Methylmercury Management* would help to minimize the  
9 increased mobilization of methylmercury at restoration areas. Therefore, the impact of  
10 contaminants is considered less than significant because it would not substantially affect Chinook  
11 salmon either directly or through habitat modifications and, with restoration, would be beneficial in  
12 the long-term. Consequently, no mitigation would be required.

### 13 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run** 14 **ESU)**

15 The expected effects of restored habitat conditions on Chinook salmon would be similar to those  
16 discussed under Impact AQUA-9, for delta smelt, which were determined to be generally beneficial.

#### 17 **CM2 Yolo Bypass Fisheries Enhancement**

18 As discussed under Impact AQUA-9, Yolo Bypass fisheries enhancement modifications are designed  
19 to increase the frequency, duration and magnitude of seasonal floodplain inundation in the Yolo  
20 Bypass. These actions would improve passage and habitat for Chinook salmon. Increased frequency  
21 of inundation will enhance the existing connectivity between the Sacramento River and the Yolo  
22 Bypass floodplain habitat, result in the increased mobilization of organic material and primary and  
23 secondary aquatic productivity, and provide additional shallow water rearing habitat for juvenile  
24 Chinook salmon. The increased inundation would also improve and expand the available migration  
25 habitat for juvenile Chinook salmon, likely with fewer predators than the mainstem river, as well as  
26 for adult Chinook salmon. These modifications, which include fish passage improvements and flow  
27 management, would reduce migratory delays and loss of adult salmon. They would also enhance  
28 rearing habitat for Sacramento River basin salmonids.

#### 29 **CM4 Tidal Natural Communities Restoration**

30 The potential effects of *CM4 Tidal Natural Communities Restoration* activities on Chinook salmon,  
31 would be similar to those discussed under Impact AQUA-9. Habitat Suitability Analysis indicates that  
32 tidal wetland restoration provides substantial increases in available habitat suitable for juvenile  
33 foraging salmon as compared to Existing Conditions, therefore this effect is not adverse. Increases in  
34 HUs for juvenile salmon are approximately 5,000 HUs each in the Cache Slough and Suisun Marsh  
35 ROAs, 2,000 HUs in the West Delta ROA, and negligible in the South Delta and Cosumnes-Mokelumne  
36 ROAs.

#### 37 **CM5 Seasonally Inundated Floodplain Restoration**

38 The potential effects of CM5 Seasonally Inundated Floodplain Restoration on Chinook salmon, would  
39 be similar to those discussed above for CM2 Yolo Bypass Fisheries Enhancement, as well as under  
40 Impact AQUA-9 Habitat conditions during juvenile rearing, including access to low- velocity,  
41 shallow- water habitat with few predators and abundant food supplies, are important for juvenile

1 growth and survival. CM5 is intended to contribute to an increase in suitable rearing habitat for  
2 juvenile salmonids within the south Delta subregion of the Plan Area, and particularly along key  
3 migration routes, which is intended to increase through-Delta survival. Seasonally inundated  
4 floodplain is expected to provide suitable rearing conditions (i.e., suitable water depths, cover from  
5 predators, food), as well as improve migration corridors.

#### 6 ***CM6 Channel Margin Enhancement***

7 Proposed channel margin enhancement activities will include 20 miles of channel margin habitat to  
8 provide rearing and outmigration habitat for juvenile salmonids. These channels include the  
9 Sacramento River between Freeport and Walnut Grove, and Steamboat and Sutter Sloughs. The  
10 affinity of Chinook salmon fry for channel margins is particularly high, and such enhancements will  
11 provide important refuge from high flows, and overhead and instream cover for protection from  
12 predators. Expanded nearshore habitat with improved inputs of terrestrial organic matter, insects,  
13 and woody material, as well as riparian shade and underwater cover, also will increase the quality of  
14 Chinook salmon rearing habitat in the Plan Area. Enhanced channel margins in the vicinity of the  
15 proposed north Delta intakes (upstream, between the intakes, and downstream) would provide  
16 resting spots and refuge for Chinook salmon moving through this area.

17 Channel margin enhancement will increase the habitat along important juvenile salmonid migration  
18 routes; consequently, the measure will improve connectivity between patches of higher value  
19 habitats and would be considered beneficial. This is particularly necessary for reaches that have  
20 very low existing habitat quality and are heavily used by salmonids—for example, the Sacramento  
21 River between Freeport and Georgiana Slough. The efficacy of the measure may depend on the  
22 lengths of enhanced channel margin habitat and the distance between enhanced areas—that is,  
23 there may be a tradeoff between enhancing multiple shorter reaches that have less distance  
24 between them and enhancing relatively few longer channel margin habitats with greater distances  
25 between them.

26 In addition to the multiple benefits identified above for enhancing channel margin habitat, there is  
27 also the potential for some negative effects. Any increase in the amount of time that Chinook salmon  
28 occupy these restored habitats, may increase exposure to any toxins sequestered in shallow-water  
29 sediments. However, the potential for effects are expected to be minimal because of the relatively  
30 short period of their life history spent in these areas. Channel margin enhancements also have the  
31 potential to provide habitat for nonnative predator species, which could increase the predation rates  
32 on Chinook salmon. Monitoring of bank protection projects and other future studies will inform site  
33 designs to limit the potential increase in such nonnative predator fish species. Overall, the effect of  
34 channel margin enhancement is expected to be beneficial for Chinook salmon.

#### 35 ***CM7 Riparian Natural Community Restoration***

##### 36 *Habitat Complexity from Riparian Restoration (CM7) in the Plan Area*

37 *CM7 Riparian Natural Community Restoration* is intended to restore riparian habitat within the  
38 context of flood control objectives and managed upstream hydrology to provide direct and indirect  
39 benefits to aquatic and terrestrial species along important migration corridors. Riparian restoration  
40 will increase instream cover through contributions of woody material derived from the riparian  
41 forest. Downed wood provides structural complexity important for resting and refuge sites used by  
42 Chinook salmon, and will contribute to creation of shaded refugia. The overall benefits of these  
43 positive effects would depend on the extent to which restored riparian areas are allowed to undergo

1 natural processes such as bank erosion, which would facilitate formation of undercut banks and  
2 introduction of complex structure into water bodies.

3 Chinook salmon would also benefit from contributions of the riparian community to the aquatic  
4 foodweb, in the form of terrestrial insects and leaf litter that enter the water, thereby increasing  
5 production of zooplankton and macroinvertebrates that provide food for Chinook salmon. Riparian  
6 vegetation also supports the formation of steep, undercut banks that provide cover for Chinook  
7 salmon. The increased habitat complexity provided by riparian restorations is expected to be  
8 beneficial to Chinook salmon.

9 **CM10 Nontidal Marsh Restoration**

10 *CM10 Nontidal Marsh Restoration* will have minor indirect beneficial effects on Chinook salmon in  
11 the main river systems and Delta. These upland wetlands provide hydrologic and water quality  
12 functions such as storing water during floods and filtering contaminants. These sites would also  
13 provide some additional food resources such as insects, zooplankton, phytoplankton and dissolved  
14 organic carbon. These materials would be exported during flood stages when the upland might be  
15 connected to the river system. Although the contribution from 400 acres would be small, it would be  
16 beneficial.

17 **NEPA Effects:** The effects of floodplain, tidal, channel margin and riparian habitat restoration  
18 activities on winter-run Chinook salmon are expected to be beneficial, providing increased amounts  
19 and quality of available habitat, increasing habitat diversity, increasing overall productivity and  
20 reducing predation. In addition, besides providing increased habitat, Yolo Bypass enhancements  
21 would also reduce migratory delays and loss of adult salmon and improve overall passage  
22 conditions.

23 Despite the improvements in habitat and habitat functions in the Delta from floodplain, tidal,  
24 channel margin and riparian habitat restoration activities, habitat quality is expected to decline in  
25 the LLT primarily because of climate change. The overall effect of restoration activities is expected  
26 to remain beneficial for winter-run Chinook salmon.

27 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
28 management plan would be needed to determine an operational protocol that optimizes benefits  
29 both locally and in adjacent habitats.

30 **CEQA Conclusion:** The overall effects of floodplain, tidal, channel margin and riparian habitat  
31 restoration activities are expected to be beneficial for winter-run Chinook salmon, providing  
32 increased amounts and quality of available habitat, increasing habitat diversity, increasing overall  
33 productivity and reducing predation. In addition, besides providing increased habitat, Yolo Bypass  
34 enhancements would reduce migratory delays and loss of adult salmon and improve passage  
35 conditions. Despite the improvements in habitat and habitat functions in the Delta from floodplain,  
36 tidal, channel margin and riparian habitat restoration activities, habitat quality is expected to  
37 decline in the LLT primarily because of climate change. However, the overall impact of restoration  
38 activities is expected to remain beneficial for Chinook salmon because they increase habitat.  
39 Consequently, no mitigation would be required.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
3 **ESU) (CM12)**

4 Refer to Impact AQUA-10 under delta smelt for a discussion of the expected effects of  
5 methylmercury management on winter-run Chinook salmon.

6 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
7 **(Winter-Run ESU) (CM13)**

8 Potential impacts on Chinook salmon from long-term IAV control are similar to those discussed for  
9 delta smelt (see Impact AQUA-11), although greater beneficial effects are likely to occur with  
10 Chinook salmon, as they occupy habitat near aquatic vegetation to a greater extent than delta smelt.  
11 The control of SAV is expected to reduce predation mortality for Chinook salmon, as predation on  
12 juvenile salmon in the migration corridor can be significant. Removing SAV is expected to reduce  
13 predator habitat and potentially reduce the population of nonnative predatory fish. IAV control is  
14 also expected to increase rearing habitat for Chinook salmon and result in an increase in available  
15 food resources.

16 **NEPA Effects:** The overall effect of IAV removal and control is expected to be beneficial to Chinook  
17 salmon.

18 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to Chinook salmon during  
19 operations through chemical and mechanical treatment and should reduce predation mortality,  
20 increase food availability and increase the amount of suitable rearing habitat for juvenile salmonids.  
21 This impact is expected to be beneficial, so no mitigation would be required.

22 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
23 **Run ESU) (CM14)**

24 As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very similar to Existing  
25 Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP export service areas  
26 (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14 Stockton Deepwater*  
27 *Ship Channel Dissolved Oxygen Levels* management would increase the dissolved oxygen levels in the  
28 Stockton Deep Water Ship Channel. Winter-run Chinook salmon do not occupy the channel, and  
29 would not be affected.

30 **NEPA Effects:** Implementation of *CM14 Stockton Deepwater Ship Channel Dissolved Oxygen Levels*  
31 would not affect habitat conditions for winter-run Chinook.

32 **CEQA Conclusion:** *CM14 Stockton Deepwater Ship Channel Dissolved Oxygen Levels* would increase  
33 dissolved oxygen levels in the Stockton Deepwater Ship Channel. Winter-run Chinook salmon do not  
34 occupy the channel. Consequently, implementation of *CM14 Stockton Deepwater Ship Channel*  
35 *Dissolved Oxygen Levels* would have no impact on habitat conditions for winter-run Chinook and no  
36 mitigation would be required.

1 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
2 **(Winter-Run ESU) (CM15)**

3 **NEPA Effects:** To the extent that localized predator control efforts of *CM15 Localized Reduction of*  
4 *Predatory Fish* reduce the local abundance of fish predators in the Delta occupied by juvenile  
5 Chinook salmon (predation on adult Chinook salmon is minimal), it is possible, but not assured that  
6 there would be some reduction in losses to predation (see Impact AQUA-13). Due to these  
7 uncertainties, there would be no demonstrable effect of this conservation measure on Chinook  
8 salmon.

9 **CEQA Conclusion:** Due to the uncertainties associated with this CM, there would be no demonstrable  
10 effect on Chinook salmon. Consequently, no mitigation would be required.

11 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
12 **(CM16)**

13 NPBs are designed to guide juvenile salmonid fish away from migration routes with low survival and  
14 high predation risk, such as the head of Old River and Georgiana Slough. Tools such as the Delta  
15 Passage Model can be used to assess reach-specific mortality rates. This model incorporates studies  
16 of tagged juvenile smolts to estimate mortality in different reaches, presumably by predation losses  
17 as described in *BDCP Effects Analysis – Appendix 5C, Flow, Passage, Salinity, and Turbidity, Section*  
18 *5C.4.3.2.2 Juvenile Chinook Salmon through-Delta Survival (Delta Passage Model), hereby incorporated*  
19 *by reference*). Perry et al. (2010) observed higher juvenile salmon survival in the mainstem  
20 Sacramento River compared to routes through the central Delta via the DCC and Georgiana Slough.  
21 Brandes and McLain (2001) found that smolts traveling through the mainstem San Joaquin River  
22 had twice the survival as tagged fish released on the upper Old River, where they presumably  
23 passed through the central Delta. These results indicate that effective NPBs may reduce predation  
24 losses of outmigrating smolts.

25 The physical structures of the NPB may attract piscivorous fish to the area and increase localized  
26 predation risks. Studies on the NPB at the head of Old River indicate that the barrier is very effective  
27 at deterring salmon smolts from entering the Old River. However, many predators were attracted to  
28 a nearby deep scour hole immediately downstream on the San Joaquin River and establishment of a  
29 large in-water structure. In fact, while the NPB deterrence rate was 81%, the predation rate was so  
30 high that the juvenile salmon survival rate was not statistically different whether the barrier was on  
31 or off (Bowen et al. 2010).

32 **NEPA Effects:** The effects of NPBs would not be adverse.

33 **CEQA Conclusion** NPBs are designed to guide juvenile salmonid fish away from migration routes  
34 with low survival and high predation risk, such as the head of Old River and Georgiana Slough. The  
35 Delta Passage Model incorporates studies of tagged juvenile salmonids to estimate mortality  
36 presumably by predation losses as described in *BDCP Effects Analysis – Appendix 5C, Flow, Passage,*  
37 *Salinity, and Turbidity, Section 5C.4.3.2.2 Juvenile Chinook Salmon through-Delta Survival (Delta*  
38 *Passage Model), hereby incorporated by reference*). Studies have shown higher survival rates in both  
39 the Sacramento River (Perry et al. 2010) and the San Joaquin River (Brandes and McLain 2001)  
40 indicating that effective NPBs may reduce predation losses of outmigrating smolts. On the other  
41 hand at the NPB at the head of Old River high predation rates were observed (Bowen et al. 2010).  
42 Overall, however, the impacts of *CM15 Localized Reduction of Predatory Fish* are expected to be

1 less than significant to slightly beneficial because they would reduce Chinook salmon entrainment  
2 which would potentially increase their numbers. Consequently, no mitigation would be required.

3 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
4 **(CM17)**

5 **NEPA Effects:** *CM17 Illegal Harvest Reduction* would be applied to benefit native sport fish (i.e.,  
6 Chinook salmon, Central Valley steelhead, green sturgeon and white sturgeon and are expected to  
7 have positive effects on these species because it would reduce the number of illegally harvested fish  
8 which would increase their number. Therefore, the impacts on winter-run Chinook salmon would be  
9 beneficial.

10 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to benefit native sport fish (i.e.,  
11 Chinook salmon, Central Valley steelhead, green sturgeon and white sturgeon) and are expected to  
12 have positive effects on these species. The impacts on winter-run Chinook salmon would be  
13 beneficial because it would reduce the number of illegally harvested fish which would increase their  
14 number. Consequently, no mitigation would be required.

15 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
16 **(CM18)**

17 **NEPA Effects:** *CM18 Conservation Hatcheries* would establish new and expand existing conservation  
18 propagation programs for delta and longfin smelt. This conservation measure would have no effect  
19 on winter-run Chinook salmon.

20 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing  
21 conservation propagation programs for delta and longfin smelt. This conservation measure would  
22 have no impact on winter-run Chinook salmon. Consequently, no mitigation would be required.

23 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
24 **ESU) (CM19)**

25 The effects of urban stormwater treatment (CM19) would reduce contaminants associated with  
26 urban areas because it provides for the treatment of stormwater discharges. As discussed in Chapter  
27 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
28 *Organophosphate Pesticides, and Organochlorine Pesticides,* stormwater treatment would reduce  
29 urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and other  
30 contaminants. These reductions would contribute to improved water quality in the Delta.

31 **NEPA Effects:** Based on the improved overall water quality conditions and reduced pesticides the  
32 effect would be beneficial.

33 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
34 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
35 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
36 *Organophosphate Pesticides, and Organochlorine Pesticides,* stormwater treatment would reduce  
37 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
38 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore,  
39 the impacts of urban stormwater treatment would have a beneficial effect both directly and through  
40 habitat modifications on Chinook salmon. Consequently, no mitigation would be required.

1 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
2 **(Winter-Run ESU) (CM21)**

3 There is no evidence of substantial entrainment of covered fish species at agricultural diversions in  
4 the Plan Area, but some entrainment likely is occurring. Whatever entrainment is occurring would  
5 be reduced by decommissioning agricultural diversions in the ROAs. PTM runs and extrapolations to  
6 a hypothetical number of diversions to be removed from the ROAs (i.e., approximately 4–12% of  
7 diversions) estimated slight reductions in entrainment for delta smelt and longfin smelt.

8 **NEPA Effects:** While the amount of reduced entrainment for Chinook salmon might be lower, the  
9 effects would be beneficial.

10 **CEQA Conclusion:** There is no evidence of substantial entrainment of covered fish species at  
11 agricultural diversions in the Plan Area, but some entrainment likely is occurring. Whatever  
12 entrainment is occurring would be reduced by decommissioning agricultural diversions in the ROAs.  
13 PTM runs and extrapolations to a hypothetical number of diversions to be removed from the ROAs  
14 (i.e., approximately 4–12% of diversions) estimated slight reductions in entrainment for delta smelt  
15 and longfin smelt. While the amount of reduced entrainment for Chinook salmon might be lower the  
16 impacts would be beneficial because it would reduce entrainment which would have a positive  
17 impact on Chinook salmon numbers. Consequently, no mitigation would be required.

18 **Spring-Run Chinook Salmon**

19 **Construction and Maintenance of CM1**

20 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
21 **(Spring-Run ESU)**

22 **Temporary Increases in Turbidity**

23 Effects on spring-run Chinook salmon from temporary increases in turbidity during construction  
24 would be similar to those described for winter-run Chinook salmon (see Impact AQUA-37). Effects  
25 would be avoided and minimized through timing restrictions and by implementing the  
26 environmental commitments *Environmental Training; Stormwater Pollution Prevention Plan; Erosion*  
27 *and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment,*  
28 *and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* and  
29 *Barge Operations Plan* (see Appendix 3B, *Environmental Commitments* and Impact AQUA-1 for delta  
30 smelt for details of these plans).

31 **Accidental Spills**

32 Effects on spring-run Chinook salmon from accidental spills during construction would be similar to  
33 those described for winter-run Chinook salmon (see Impact AQUA-37 for winter-run Chinook  
34 salmon). Effects would be minimized by implementing the environmental commitments described  
35 under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments,*  
36 *(Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
37 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan),*  
38 specifically the *Spill Prevention, Containment, and Countermeasure Plan.*

1       **Disturbance of Contaminated Sediments**

2       Potential effects on spring-run Chinook salmon from disturbance of contaminated sediments during  
3       construction are similar to those described for winter-run Chinook salmon (see Impact AQUA-37 for  
4       winter-run Chinook salmon). Effects would be minimized by implementing the environmental  
5       commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
6       *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
7       *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
8       *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
9       *and Salvage Plan; and Barge Operations Plan).*

10       **Underwater Noise**

11       Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
12       fish, including Chinook salmon (see Impact AQUA-1 for delta smelt). Table 11-4 illustrates the  
13       species and life stages of Chinook salmon expected to be present in the north, east, and south Delta  
14       during the expected in-water construction window (June 1–October 31). Spring-run Chinook salmon  
15       eggs and fry would not experience underwater sound because the locations of the intakes and barge  
16       landings are not considered suitable habitat for these two life stages of this species, and they would  
17       not be present during the in-water construction period (typically June to October). Therefore, these  
18       life history stages would not be affected.

19       Adult spring-run Chinook salmon would have a moderate potential to be in the north Delta in June  
20       and a low potential to be in the north Delta in July during intake construction activities. Juvenile  
21       spring-run Chinook salmon would not occur near the intakes or barge landings during the in-water  
22       construction period (typically June to October).

23       Table 11-8 illustrates the estimated area where the cumulative SEL threshold would be exceeded if  
24       impact pile driving is required during construction. All juveniles exposed to underwater noise would  
25       be expected to be larger than the 2-gram size threshold, based on the typical length at age and the  
26       length to weight relationship observed for Chinook salmon occurring in the Delta (Myers et al. 1998;  
27       Kimmerer et al. 2005). On this basis, juveniles exposed to underwater noise in excess of 187 dB  
28       SEL<sub>cumulative</sub> would be expected to experience injury-level adverse effects. These effects would be  
29       avoided and minimized through implementation of Mitigation Measures AQUA-1a and/or AQUA-1b.

30       **Fish Stranding**

31       Effects on spring-run Chinook salmon from fish stranding during construction would be similar to  
32       those described for winter-run Chinook salmon (see Impact AQUA-37 for winter-run Chinook  
33       salmon). Adverse effects would be minimized by limiting in-water work to approved in-water work  
34       windows and implementing the *Fish Rescue and Salvage Plan* environmental commitment (see  
35       Impact AQUA-1 and Appendix 3B, *Environmental Commitments*).

36       **In-Water Work Activities**

37       Effects on spring-run Chinook salmon from in-water work activities during construction would be  
38       similar to those described for winter-run Chinook salmon (see Impact AQUA-37 for winter-run  
39       Chinook salmon). Effects would be minimized by implementing of environmental commitments  
40       described in Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment Control*  
41       *Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*  
42       Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

1 **Loss of Spawning, Rearing, or Migration Habitat**

2 Effects on spring-run Chinook salmon from loss of spawning, rearing or migration habitat during  
3 construction would be similar to those described for winter-run Chinook salmon (see Impact AQUA-  
4 37 for winter-run Chinook salmon). Effects would be minimized by implementation of  
5 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
6 *Environmental Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of Spoils, Reusable*  
7 *Tunnel Material, and Dredged Material*; and *Barge Operations Plan*. Pertinent details of these plans  
8 are provided under Impact AQUA-1.

9 **Predation**

10 Effects on spring-run Chinook salmon from predation during construction would be similar to those  
11 described for winter-run Chinook salmon (see Impact AQUA-37 for winter-run Chinook salmon).

12 **NEPA Effects:** Potential effects of construction of the water conveyance facilities on spring-run  
13 Chinook salmon would be similar to those discussed for winter-run Chinook salmon (see Impact  
14 AQUA-37 for winter run Chinook salmon). Construction of Alternative 1A involves several elements  
15 with the potential to cause adverse effects on spring-run Chinook salmon. However, these turbidity  
16 and hazardous material spill effects will be effectively avoided and/or minimized in most cases  
17 through implementation of environmental commitments (see Impact AQUA-1 and Appendix 3B,  
18 *Environmental Commitments: Environmental Training; Stormwater Pollution Prevention Plan; Erosion*  
19 *and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment,*  
20 *and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish*  
21 *Rescue and Salvage Plan; and Barge Operations Plan);* conservation measures; and through  
22 implementation of the avoidance and minimization measures included in Mitigation Measures  
23 AQUA-1a and AQUA-1b. The effects would unlikely be adverse for spring-run Chinook salmon.

24 **CEQA Conclusion:** The potential impact on spring-run Chinook salmon from construction activities  
25 would be considered less than significant due to implementation of the environmental commitments  
26 described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*,  
27 such as *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control*  
28 *Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure*  
29 *Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage*  
30 *Plan; and Barge Operations Plan*. These measures would be expected to protect Chinook salmon  
31 from any adverse water quality effect (turbidity, spills of hazardous materials) resulting from  
32 project construction. Construction would not be expected to increase predation rates relative to  
33 NAA. Construction associated with Alternative 1A will result in both temporary and permanent  
34 alteration of rearing and migratory habitats used by Chinook salmon. However, these effects are not  
35 expected to be significant because the loss of habitat is not substantial compared to the amount of  
36 habitat currently available in combination with the amount of new habitat that would result from  
37 restoration. The direct effects of underwater construction noise on Chinook salmon would be a  
38 significant impact because of the high likelihood that it would cause injury or death to most  
39 impacted fish in the immediate vicinity of the activity. However, implementation of Mitigation  
40 Measures AQUA-1a and AQUA-1b would minimize the potential effects from underwater noise and  
41 would reduce the severity of impacts to a less-than-significant level.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

7           **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
8           **(Spring-Run ESU)**

9           ***Temporary Increases in Turbidity***

10          Effects on spring-run Chinook salmon from temporary increases in turbidity during construction  
11          would be similar to those described for winter-run Chinook salmon (see Impact AQUA-38 for  
12          winter-run Chinook salmon). Effects would be avoided and minimized through timing restrictions  
13          and by implementing the environmental commitments *Environmental Training; Stormwater*  
14          *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*  
15          *Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel*  
16          *Material, and Dredged Material; and Barge Operations Plan* (see Appendix 3B, *Environmental*  
17          *Commitments* and Impact AQUA-1 for delta smelt for details of these plans).

18          ***Accidental Spills***

19          Effects on spring-run Chinook salmon from accidental spills would be similar to those described for  
20          winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook salmon). Effects would  
21          also be avoided and minimized by implementing the environmental commitments *Environmental*  
22          *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
23          *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of*  
24          *Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan* (see Appendix 3B,  
25          *Environmental Commitments* and Impact AQUA-1 for delta smelt for details of these plans).

26          ***Underwater Noise***

27          Effects on spring-run Chinook salmon from underwater noise would be similar to those described  
28          for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook salmon).

29          ***Maintenance-Related Disturbance***

30          Effects on spring-run Chinook salmon from in-water work activities would be similar to those  
31          described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook salmon).  
32          Effects would be minimized by implementation of environmental commitments including  
33          *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
34          *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;* and  
35          *Barge Operations Plan*, described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
36          *Environmental Commitments*.

1 **Loss of Spawning, Rearing, or Migration Habitat**

2 Effects on spring-run Chinook salmon from loss of spawning, rearing or migration habitat would be  
3 similar to those described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run  
4 Chinook salmon). Effects would be minimized by implementation of environmental commitments  
5 described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*.

6 **Predation**

7 Effects on spring-run Chinook salmon from predation during maintenance would be similar to those  
8 described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook salmon).

9 **Summary**

10 In-water maintenance activities would be scheduled to occur when the least numbers of Chinook  
11 salmon would be present in or near the maintenance areas. Such activities would include  
12 maintenance dredging at the intake sites, and installation or repair of riprap bank armoring.  
13 Implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
14 and in Appendix 3B, *Environmental Commitments*, would further minimize or eliminate turbidity and  
15 hazardous spill effects on Chinook salmon. These environmental commitments include  
16 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
17 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;* and  
18 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans  
19 are provided under Impact AQUA-1 for delta smelt.

20 Implementation of these environmental commitments, along with the low numbers of Chinook  
21 salmon expected to occur in the maintenance areas during the expected in-water work windows and  
22 the limited frequency and duration of in-water maintenance activities, would result in a low  
23 potential for adverse effects on Chinook salmon. In addition, no spawning habitat occurs in the areas  
24 potentially affected by maintenance activities, and ample rearing, and migration habitat of the same  
25 quality is readily accessible in the area, and this habitat would not be substantially affected by  
26 maintenance activities.

27 **NEPA Effects:** The short-term maintenance activities would not adversely affect Chinook salmon.

28 **CEQA Conclusion:** In addition to the limited frequency and duration of in-water maintenance  
29 activities, implementation of the environmental commitments identified above and described in  
30 detail under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*, would  
31 minimize the potential for turbidity and hazardous spills from maintenance activities to affect  
32 Chinook salmon by reducing the amount of turbidity and guiding the rapid and effective response to  
33 inadvertent spills of hazardous materials. These environmental commitments described in greater  
34 detail under Impact AQUA-1 for delta smelt, include *Environmental Training; Stormwater Pollution*  
35 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
36 *Prevention, Containment, and Countermeasure Plan;* and *Disposal of Spoils, Reusable Tunnel Material,*  
37 *and Dredged Material*. Potential changes to rearing and migratory habitat would also be limited and  
38 temporary. Therefore, the potential impact of maintenance activities is considered less than  
39 significant because it would not substantially reduce Chinook salmon habitat, restrict its range, or  
40 interfere with its movement. Consequently no mitigation would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
3 **ESU)**

4 ***Water Exports from SWP/CVP South Delta Facilities***

5 Entrainment of spring-run Chinook salmon at the south Delta export facilities, as estimated by the  
6 salvage density method, would be 14% lower under Alternative 1A compared to NAA when  
7 averaged across all water years (Table 11-1A-20). This was driven by 65% reduced entrainment in  
8 wet years. However, entrainment would be greater in drier years, ranging from 11% more in critical  
9 years to 51% more in below normal years. Pre-screen predation losses at the south Delta facilities  
10 would change commensurate with the changes in entrainment described above, increasing in drier  
11 years and decreasing in wet years. Increased entrainment during drier years may have a population-  
12 level impact on spring-run Chinook salmon since recruitment levels are lower during these years.

13 **Table 11-1A-20. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index<sup>a</sup> at the**  
14 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 1A**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-56,160 (-63%)	-59,788 (-65%)
Above Normal	2,331 (9%)	-737 (-2%)
Below Normal	4,446 (70%)	3,651 (51%)
Dry	9,770 (59%)	8,576 (49%)
Critical	-527 (-4%)	1,094 (11%)
All Years	-3,778 (-10%)	-5,389 (-14%)

Shading indicates >5% increased entrainment.

Note: Estimated annual index of fish lost, based on normalized salvage densities.

15  
16 The proportion of the annual spring-run population entrained would decrease under Alternative 1A  
17 across all years compared to NAA conditions (*BDCP Effects Analysis – Appendix 5.B Entrainment,*  
18 *Section 5B.5.4.4, herein incorporated by reference*). Under the assumption that the annual number of  
19 juvenile spring-run Chinook salmon juveniles approaching the Delta was 750,000 fish, the  
20 percentage of the population lost to entrainment across all years averaged would be 4.5-5.0% under  
21 Alternative 1A, similar to NAA (5.0–5.3%).

22 These percentages are probably an overestimate because the length-based classification method  
23 may classify fall-run Chinook salmon as spring-run.

24 ***Water Exports from SWP/CVP North Delta Intake Facilities***

25 As described for winter-run Chinook salmon (Impact AQUA-39), potential entrainment of spring-run  
26 Chinook salmon at the north Delta intakes occurs only under the action alternatives, including  
27 Alternative 1A. The effects would be minimal because the north Delta intakes would be screened to  
28 exclude juvenile fish, including juvenile spring-run Chinook salmon.

1 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

2 The effects would be similar to those described for Impact AQUA-39. Entrainment and impingement  
3 effects for spring-run Chinook salmon would be minimal because intakes would have state-of-the-  
4 art screens installed.

5 **NEPA Effects:** Under Alternative 1A, entrainment of juvenile spring-run Chinook salmon at the south  
6 Delta facilities would decrease 14% on average, but would increase 11% to 51% in drier years. The  
7 north Delta intakes would be screened to exclude juvenile fish, and monitored to ensure fish screen  
8 performance consistent with design specifications. As a result of increased south Delta entrainment  
9 in drier years, this effect is adverse.

10 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
11 SWP/CVP south Delta facilities would decrease in entrainment of spring-run Chinook salmon in wet  
12 years, but would increase entrainment in above normal (9% increase), below normal (70%  
13 increase) and dry (59% increase) water years. There is also entrainment risk at the proposed north  
14 Delta facilities, although screening would avoid this. The overall impact of Alternative 1A on  
15 entrainment of spring-run Chinook salmon would be significant due to increased south Delta  
16 entrainment.

17 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
18 **Chinook Salmon (Spring-Run ESU)**

19 In general, Alternative 1A would reduce spawning and egg incubation habitat for spring-run  
20 Chinook salmon relative to NAA.

21 **Sacramento River**

22 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
23 salmon spawning and incubation period (September through January) type (Appendix 11C, *CALSIM*  
24 *II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be similar to or  
25 up to 33% greater than flows under NAA, except during September and November, in which flows  
26 would be up to 44% lower.

27 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam  
28 during the spring-run spawning and egg incubation period (September through January). Storage  
29 under A1A\_LLT would be greater than storage under NAA in wet (8% higher) and above normal  
30 (5% higher) water years, 9% lower than storage under NAA in below water years, and similar to  
31 storage under NAA in dry and critical water years (Table 11-1A-21).

32 **Table 11-1A-21. Difference and Percent Difference in September Water Storage Volume (thousand**  
33 **acre-feet) in Shasta Reservoir for Alternative 1A Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-290 (-9%)	221 (8%)
Above Normal	-483 (-15%)	132 (5%)
Below Normal	-568 (-20%)	-214 (-9%)
Dry	-555 (-23%)	-44 (-2%)
Critical	-387 (-33%)	-3 (-0.4%)

34

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
 2 examined during the September through January spring-run Chinook salmon spawning period  
 3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
 4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
 5 temperature between NAA and Alternative 1A in any month or water year type throughout the  
 6 period at either location.

7 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
 8 determined for each month (May through September At Bend Bridge and October through April at  
 9 Red Bluff) and year of the 82-year modeling period (Table 11-1A-11). The combination of number of  
 10 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
 11 Table 11-1A-12. Differences between baselines and Alternative 1A in the highest level of concern  
 12 across all months and all 82 modeled years are presented in Table 11-1A-13 for Bend Bridge and in  
 13 Table 11-1A-22 for Red Bluff. There would be no difference in levels of concern between NAA and  
 14 Alternative 1A at Bend Bridge. At Red Bluff, there would be 6 (14%) and 4 (50%) fewer years with a  
 15 “red” and “yellow” level of concern, respectively, under Alternative 1A.

16 **Table 11-1A-22. Differences between Baseline and Alternative 1A Scenarios in the Number of**  
 17 **Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**  
 18 **Sacramento River at Red Bluff, October through April**

Level of Concern <sup>a</sup>	EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
Red	30 (250%)	-6 (-14%)
Orange	12 (200%)	5 (28%)
Yellow	-5 (-38%)	-4 (-50%)
None	-37 (-73%)	5 (36%)

<sup>a</sup> For definitions of levels of concern, see Table 11-1A-12.

19  
 20 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
 21 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
 22 degree-days under Alternative 1A would be up to 15% lower than those under NAA during May and  
 23 June and up to 20% higher during July through September (Table 11-1A-14). At Red Bluff, total  
 24 degree-days under Alternative 1A would be 17% higher than those under NAA during November,  
 25 13% lower during April, and similar during remaining months (Table 11-1A-23).

1  
2  
3

**Table 11-1A-23. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Red Bluff, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
October	Wet	1,087 (423%)	-82 (-6%)
	Above Normal	439 (169%)	-38 (-5%)
	Below Normal	823 (394%)	117 (13%)
	Dry	1,067 (217%)	-4 (0%)
	Critical	880 (147%)	-43 (-3%)
	All	4,296 (236%)	-50 (-1%)
November	Wet	91 (9,100%)	1 (1%)
	Above Normal	69 (NA)	8 (13%)
	Below Normal	107 (NA)	59 (123%)
	Dry	166 (2,075%)	15 (9%)
	Critical	107 (2,675%)	-3 (-3%)
	All	540 (4,154%)	80 (17%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	9 (NA)	0 (0%)
	Above Normal	6 (NA)	2 (50%)
	Below Normal	30 (333%)	9 (30%)
	Dry	59 (421%)	-5 (-6%)
	Critical	25 (2,500%)	-2 (-7%)
	All	129 (538%)	4 (3%)
April	Wet	253 (220%)	-8 (-2%)
	Above Normal	197 (141%)	-32 (-9%)
	Below Normal	226 (286%)	-4 (-1%)
	Dry	154 (83%)	-166 (-33%)
	Critical	135 (1,125%)	-16 (-10%)
	All	965 (181%)	-226 (-13%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
2 Sacramento River under A1A\_LLT would be similar to mortality under NAA in dry and critical years,  
3 but greater in wet (40% greater), above normal (24% greater), and below normal (30% greater)  
4 water years (Table 11-1A-24).

5 **Table 11-1A-24. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**  
6 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	25 (244%)	10 (40%)
Above Normal	30 (229%)	8 (24%)
Below Normal	42 (350%)	12 (30%)
Dry	56 (282%)	-1 (-2%)
Critical	22 (30%)	-0.2 (-0.2%)
All	35 (156%)	6 (12%)

7  
8 SacEFT predicts that there would be a substantial increase (57%) in the percentage of years with  
9 good spawning availability, measured as weighted useable area, between A1A\_LLT and NAA (Table  
10 11-1A-25). SacEFT predicts that there would be no difference in the percentage of years with good  
11 (lower) redd scour risk under A1A\_LLT relative to NAA (Table 11-1A-25). SacEFT predicts that there  
12 would be a 32% decrease in the percentage of years with good (lower) egg incubation conditions  
13 under A1A\_LLT relative to NAA. SacEFT predicts that there would be a 26% increase in the  
14 percentage of years with good (lower) redd dewatering risk under A1A\_LLT relative to NAA.

15 **Table 11-1A-25. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
16 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Spawning WUA	7 (10%)	28 (57%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-63 (-73%)	-11 (-32%)
Redd Dewatering Risk	-6 (-12%)	9 (26%)
Juvenile Rearing WUA	0 (0%)	0 (0%)
Juvenile Stranding Risk	-5 (-26%)	0 (0%)

WUA = Weighted Usable Area.

17  
18 **Clear Creek**  
19 Flows under A1A\_LLT would be similar to flows under NAA throughout the September through  
20 January spring-run spawning and egg incubation period for all water year types, except in critical  
21 years during September (13% reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
22 *Analysis*).

23 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
24 comparing the magnitude of flow reduction each month over the incubation period compared to the  
25 flow in September when spawning is assumed to occur. The greatest reduction in flows under

1 A1A\_LLТ during September through January would be the same as that under NAA in all water year  
2 types (Table 11-1A-26).

3 Water temperatures were not modeled in Clear Creek.

4 **Table 11-1A-26. Difference and Percent Difference in Greatest Monthly Reduction (Percent**  
5 **Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September**  
6 **through January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLТ	NAA vs. A1A_LLТ
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

7

8 **Feather River**

9 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)  
10 where spring-run Chinook primarily spawn and eggs incubate during September through January  
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLТ would  
12 not differ from NAA because minimum Feather River flows are included in the FERC settlement  
13 agreement and would be met for all model scenarios (California Department of Water Resources  
14 2006).

15 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam  
16 during the spring-run spawning and egg incubation period. Storage volume at the end of September  
17 under A1A\_LLТ would be 18% to 31% greater than storage under NAA depending on water year  
18 type (Table 11-1A-27).

19 **Table 11-1A-27. Difference and Percent Difference in September Water Storage Volume (thousand**  
20 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLТ	NAA vs. A1A_LLТ
Wet	-467 (-16%)	547 (29%)
Above Normal	-504 (-21%)	287 (18%)
Below Normal	-340 (-17%)	270 (19%)
Dry	-42 (-3%)	311 (31%)
Critical	-20 (-2%)	168 (21%)

21

22 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
23 comparing the magnitude of flow reduction each month over the egg incubation period compared to  
24 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel

during October through January were identical among A1A\_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 1A on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table 11-1A-28). The percent of months exceeding the threshold under Alternative 1A would generally be lower (up to 32% lower on an absolute scale) than the percent under NAA during October and November and similar during other months, except for the >5.0 degree category during September (5% absolute scale increase).

**Table 11-1A-28. Differences between Baseline and Alternative 1A Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River above Thermalito Afterbay Exceed the 56°F Threshold, September through January**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LLT</b>					
September	0 (0%)	1 (1%)	9 (9%)	23 (32%)	47 (115%)
October	32 (144%)	36 (483%)	25 (400%)	26 (1,050%)	20 (800%)
November	33 (1,350%)	28 (2,300%)	21 (1,700%)	12 (NA)	7 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>NAA vs. A1A_LLT</b>					
September	0 (0%)	0 (0%)	1 (1%)	0 (0%)	5 (6%)
October	-32 (-37%)	-22 (-34%)	-25 (-44%)	-21 (-43%)	-17 (-44%)
November	-31 (-46%)	-30 (-50%)	-27 (-55%)	-20 (-62%)	-17 (-70%)
December	-4 (-100%)	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during September through January (Table 11-1A-29). Total degree-months would be similar between NAA and Alternative 1A during September, December, and January, and 37% and 45% lower during October and November.

1 **Table 11-1A-29. Differences between Baseline and Alternative 1A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 56°F in the Feather River above Thermalito Afterbay, September through January**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
September	Wet	60 (56%)	35 (26%)
	Above Normal	23 (53%)	13 (25%)
	Below Normal	35 (58%)	4 (4%)
	Dry	47 (68%)	-41 (-26%)
	Critical	43 (66%)	-19 (-15%)
	All	208 (60%)	-8 (-1%)
October	Wet	39 (780%)	-57 (-56%)
	Above Normal	20 (200%)	-15 (-33%)
	Below Normal	39 (557%)	-15 (-25%)
	Dry	52 (743%)	-28 (-32%)
	Critical	28 (350%)	-13 (-27%)
	All	178 (481%)	-128 (-37%)
November	Wet	21 (NA)	-35 (-63%)
	Above Normal	14 (467%)	-11 (-39%)
	Below Normal	16 (1,600%)	-18 (-51%)
	Dry	30 (NA)	-21 (-41%)
	Critical	23 (NA)	-5 (-18%)
	All	104 (2,600%)	-90 (-45%)
December	Wet	0 (NA)	-1 (-100%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	-3 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	-4 (-80%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** In conclusion, the effect is adverse because habitat would be substantially reduced.  
 6 Spawning habitat conditions in the Sacramento River are predicted by SacEFT to improve, although  
 7 egg incubation conditions would be degraded. In addition, the Reclamation egg mortality model  
 8 predicts that there would be an 8% to 12% increase in egg mortality in wet, above normal, and  
 9 below normal years. There would be no flow- or temperature-related effects on spring-run Chinook  
 10 salmon spawning and egg incubation in Clear Creek or the Feather River. This effect is a result of the  
 11 specific reservoir operations and resulting flows associated with this alternative. Applying  
 12 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
 13 reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby

1 making it a different alternative than that which has been modeled and analyzed. As a result, this  
2 would be an unavoidable adverse effect because there is no feasible mitigation.

3 **CEQA Conclusion:** In general, Alternative 1A would reduce spawning and egg incubation habitat for  
4 spring-run Chinook salmon relative to Existing Conditions.

#### 5 **Sacramento River**

6 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
7 salmon spawning and incubation period (September through January) type (Appendix 11C, *CALSIM*  
8 *II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be similar to or  
9 up to 36% greater than flows under Existing Conditions, except during September and November, in  
10 which flows would be up to 24% lower.

11 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam  
12 during the spring-run spawning and egg incubation period (September through January). September  
13 storage under A1A\_LLT would be lower by 9% to 33% than storage under Existing Conditions in all  
14 water year types (Table 11-1A-21).

15 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
16 examined during the September through January spring-run Chinook salmon spawning period  
17 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
18 *utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 1A during September and  
19 October would be 7% and 6% greater, respectively, than those under Existing Conditions, but not  
20 different in other months during the period. At Red Bluff, temperatures under Alternative 1A during  
21 September and October would be 7% and 5% greater, respectively, than those under Existing  
22 Conditions, but not different in other months during the period.

23 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
24 determined for each month (May through September At Bend Bridge and October through April at  
25 Red Bluff) and year of the 82-year modeling period (Table 11-1A-11). The combination of number of  
26 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
27 Table 11-1A-12. Differences between baselines and Alternative 1A in the highest level of concern  
28 across all months and all 82 modeled years are presented in Table 11-1A-13 for Bend Bridge and in  
29 Table 11-1A-22 for Red Bluff. At Bend Bridge, there would be a 103% increase in the number of  
30 years with a “red” level of concern under Alternative 1A relative to Existing Conditions. At Red Bluff,  
31 there would be 250% and 200% increases in the number of years with “red” and “orange” levels of  
32 concern under Alternative 1A relative to Existing Conditions.

33 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
34 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
35 degree-days under Alternative 1A would be up to 157% to 281% higher than those under Existing  
36 Conditions depending on the month (Table 11-1A-14). At Red Bluff, total degree-days under  
37 Alternative 1A would be 181% to 4154% higher than those under Existing Conditions during  
38 October, November, March, and April, and similar during December through February (Table 11-1A-  
39 23).

40 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
41 Sacramento River under A1A\_LLT would be 30% to 350% higher than mortality under Existing  
42 Conditions depending on water year type (Table 11-1A-24).

1 SacEFT predicts that there would be a 10% increase in the percentage of years with good spawning  
2 availability, measured as weighted useable area, between A1A\_LLT and Existing Conditions (Table  
3 11-1A-25). SacEFT predicts that there would be no difference in the percentage of years with good  
4 (lower) redd scour risk under A1A\_LLT relative to Existing Conditions (Table 11-1A-25). SacEFT  
5 predicts that there would be a 73% decrease in the percentage of years with good (lower) egg  
6 incubation conditions under A1A\_LLT relative to Existing Conditions. SacEFT predicts that there  
7 would be a 12% decrease in the percentage of years with good (lower) redd dewatering risk under  
8 A1A\_LLT relative to Existing Conditions.

### 9 **Clear Creek**

10 Flows under A1A\_LLT would be similar to flows under Existing Conditions throughout the  
11 September through January spring-run spawning and egg incubation period for all water year types,  
12 except in critical years during September (37% reduction) (Appendix 11C, *CALSIM II Model Results*  
13 *utilized in the Fish Analysis*).

14 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
15 comparing the magnitude of flow reduction each month over the incubation period compared to the  
16 flow in September when spawning is assumed to occur. The greatest reduction in flows under  
17 A1A\_LLT during September through January would be the same or lower than the reduction under  
18 Existing Conditions in wet and below normal water year types and greater by 27%, 67%, and 33%  
19 then Existing Conditions in above normal, dry, and critical water years, respectively (Table 11-1A-  
20 26).

21 Water temperatures were not modeled in Clear Creek.

### 22 **Feather River**

23 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)  
24 where spring-run Chinook primarily spawn during September through January (Appendix 11C,  
25 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would not differ from  
26 Existing Conditions because minimum Feather River flows are included in the FERC settlement  
27 agreement and would be met for all model scenarios (California Department of Water Resources  
28 2006).

29 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam  
30 during the spring-run spawning and egg incubation period. Storage volume at the end of September  
31 under A1A\_LLT would be similar to storage under Existing Conditions in dry and critical water  
32 years, but 16% to 21% in wet, above normal, and below normal water years (Table 11-1A-27).

33 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
34 comparing the magnitude of flow reduction each month over the egg incubation period compared to  
35 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
36 during October through January were identical among A1A\_LLT and Existing Conditions (Appendix  
37 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of  
38 Alternative 1A on redd dewatering in the Feather River low-flow channel.

39 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream  
40 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water*  
41 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

1 Temperatures under Alternative 1A would be 7% to 10% greater than those under Existing  
2 Conditions in all months during the period except September.

3 The percent of months exceeding the 56°F temperature threshold in the Feather River above  
4 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table  
5 11-1A-28). The percent of months exceeding the threshold under Alternative 1A would be similar to  
6 or up to 47% higher (absolute scale) than under Existing Conditions during September through  
7 November. There would be no difference in the percent of months exceeding the threshold between  
8 Existing Conditions and alternative 1A during December and January.

9 Total degree-days exceeding 56°F were summed by month and water year type above Thermalito  
10 Afterbay (low-flow channel) during September through January (Table 11-1A-29). Total degree-  
11 months exceeding the threshold under Alternative 1A would be 60% to 2600% greater than those  
12 under Existing Conditions during September through November. There would be no difference in  
13 total degree-months between Existing Conditions and Alternative 1A during December and January.

#### 14 **Summary of CEQA Conclusion**

15 Collectively, the results indicate that the difference between the CEQA baseline and Alternative 1A is  
16 significant because the alternative could substantially reduce the number of fish as a result of  
17 degraded spawning habitat conditions and egg mortality in the Sacramento and Feather Rivers and  
18 in Clear Creek. Shasta reservoir storage would be substantially reduced at the end of September  
19 under Alternative 1A relative to Existing Conditions, which would alter flows and increase water  
20 temperatures in the Sacramento River to above NMFS thresholds substantially more frequently. This  
21 would lead to degraded egg incubation conditions, as predicted by SacEFT, and increased egg  
22 mortality, as predicted by the Reclamation egg mortality model. Flows would generally not differ in  
23 the Feather and Clear Creek between Existing Conditions and Alternative 1A although water  
24 temperatures and the exceedance of NMFS temperature thresholds would increase under  
25 Alternative 1A in the Feather River during the majority of months evaluated. This impact is a result  
26 of the specific reservoir operations and resulting flows associated with this alternative. Applying  
27 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
28 reduce this impact to a less-than-significant level would fundamentally change the alternative,  
29 thereby making it a different alternative than that which has been modeled and analyzed. As a  
30 result, this impact is significant and unavoidable because there is no feasible mitigation available.  
31 Even so, proposed below is mitigation that has the potential to reduce the severity of impact though  
32 not necessarily to a less-than-significant level.

#### 33 **Mitigation Measure AQUA-58a: Following Initial Operations of CM1, Conduct Additional** 34 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine** 35 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

36 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
37 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
38 the best available scientific information at the time and may prove to have been over- or  
39 understated. Upon the commencement of operations of CM1 and continuing through the life of  
40 the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine  
41 whether such effects would be as extensive as concluded at the time of preparation of this  
42 document and to determine any potentially feasible means of reducing the severity of such

1 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
2 consistent with the operational framework for Alternative 1A.

3 The development and implementation of any mitigation actions shall be focused on those  
4 incremental effects attributable to implementation of Alternative 1A operations only.  
5 Development of mitigation actions for the incremental impact on spawning habitat attributable  
6 to climate change/sea level rise are not required because these changed conditions would occur  
7 with or without implementation of Alternative 1A.

8 **Mitigation Measure AQUA-58b: Conduct Additional Evaluation and Modeling of Impacts**  
9 **on Spring-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

10 Following commencement of initial operations of CM1 and continuing through the life of the  
11 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
12 modified operations could reduce impacts to spawning habitat under Alternative 1A. The  
13 analysis required under this measure may be conducted as a part of the Adaptive Management  
14 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

15 **Mitigation Measure AQUA-58c: Consult with USFWS and CDFW to Identify and Implement**  
16 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Spawning**  
17 **Habitat Consistent with CM1**

18 In order to determine the feasibility of reducing the effects of CM1 operations on spring-run  
19 Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of  
20 Fish and Wildlife to identify and implement any feasible operational means to minimize effects  
21 on spawning habitat. Any such action will be developed in conjunction with the ongoing  
22 monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-40a.

23 If feasible means are identified to reduce impacts on spawning habitat consistent with the  
24 overall operational framework of Alternative 1A without causing new significant adverse  
25 impacts on other covered species, such means shall be implemented. If sufficient operational  
26 flexibility to reduce effects on spring-run Chinook salmon habitat is not feasible under  
27 Alternative 1A operations, achieving further impact reduction pursuant to this mitigation  
28 measure would not be feasible under this Alternative, and the impact on spring-run Chinook  
29 salmon would remain significant and unavoidable.

30 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**  
31 **Run ESU)**

32 In general, Alternative 1A would not affect the quantity and quality of rearing habitat for fry and  
33 juvenile spring-run Chinook salmon relative to NAA.

34 ***Sacramento River***

35 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
36 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
37 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows between December  
38 and July under A1A\_LLT would generally be similar to or greater than those under NAA. Flows  
39 during November would be lower (by up to 30%) under A1A\_LLT than under NAA.

1 As reported for Alternative 1A (Impact AQUA-40 for spring-run Chinook salmon), May Shasta  
2 storage volume under A1A\_LLT would be similar to or up to 8% lower than storage under NAA for  
3 all water year types (Table 11-1A-10).

4 As reported in Impact AQUA-58, September Shasta storage volume would be greater than storage  
5 under NAA in wet (8% higher) and above normal (5% higher) water years, 9% lower than storage  
6 under NAA in below water years, and similar to storage under NAA in dry and critical water years  
7 (Table 11-1A-21).

8 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
9 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
10 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
11 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
12 NAA and Alternative 1A in any month or water year type throughout the period at either location.

13 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions and  
14 juvenile stranding risk under A1A\_LLT would be similar to that under NAA (Table 11-1A-25).

15 SALMOD predicts that spring-run smolt equivalent habitat-related mortality would be 7% lower  
16 under A1A\_LLT than NAA.

#### 17 **Clear Creek**

18 Flows in Clear Creek during the November through March rearing period under A1A\_LLT would  
19 generally be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II Model Results*  
20 *utilized in the Fish Analysis*).

21 Water temperatures were not modeled in Clear Creek.

#### 22 **Feather River**

23 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
24 channel) during November through June were reviewed to determine flow-related effects on larval  
25 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
26 *Analysis*). Relatively constant flows in the low flow channel throughout this period under A1A\_LLT  
27 would not differ from those under NAA. In the high flow channel, flows under A1A\_LLT would be  
28 mostly greater by up to 110% than flows under NAA during November through June with few  
29 exceptions during which flows would be similar to, or up to 15% lower, than under NAA.

30 May Oroville storage under A1A\_LLT would be similar to storage under NAA, except for dry years  
31 (5% higher) (Table 11-1A-30).

32 As reported for Alternative 1A (Impact AQUA-58 for spring-run Chinook salmon), September  
33 Oroville storage volume would be 18% to 31% greater than under NAA depending on water year  
34 type (Table 11-1A-27).

1 **Table 11-1A-30. Difference and Percent Difference in May Water Storage Volume (thousand acre-**  
2 **feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-91 (-3%)	-45 (-1%)
Above Normal	-237 (-7%)	-81 (-2%)
Below Normal	-379 (-12%)	-26 (-1%)
Dry	-410 (-15%)	110 (5%)
Critical	-260 (-14%)	57 (4%)

3  
4 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
5 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
6 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
8 between NAA and Alternative 1A in any month or water year type throughout the period at either  
9 location.

10 The percent of months exceeding the 63°F temperature threshold in the Feather River above  
11 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-1A-  
12 31). The percent of months exceeding the threshold under Alternative 1A would generally be similar  
13 to or lower (up to 19% lower on an absolute scale) than the percent under NAA.

14 **Table 11-1A-31. Differences between Baseline and Alternative 1A Scenarios in Percent of Months**  
15 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
16 **River above Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LLT</b>					
May	2 (NA)	2 (NA)	0 (NA)	0 (NA)	0 (NA)
June	27 (49%)	32 (118%)	30 (600%)	12 (NA)	2 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	49 (125%)
August	0 (0%)	12 (14%)	35 (60%)	49 (174%)	42 (425%)
<b>NAA vs. A1A_LLT</b>					
May	-4 (-60%)	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)
June	-6 (-7%)	-19 (-24%)	-12 (-26%)	-9 (-41%)	-2 (-50%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-5 (-5%)
August	0 (0%)	0 (0%)	-6 (-6%)	-4 (-5%)	-5 (-9%)

NA = could not be calculated because the denominator was 0.

17  
18 Total degree-days exceeding 63°F were summed by month and water year type above Thermalito  
19 Afterbay (low-flow channel) during May through August (Table 11-1A-32). Total degree-months  
20 under Alternative 1A would be similar to or lower than those under NAA depending on the month.

1 **Table 11-1A-32. Differences between Baseline and Alternative 1A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 63°F in the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
May	Wet	1 (NA)	0 (0%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	3 (NA)	-1 (-25%)
	All	7 (NA)	-1 (-13%)
June	Wet	27 (180%)	-2 (-5%)
	Above Normal	14 (100%)	-3 (-10%)
	Below Normal	19 (146%)	-3 (-9%)
	Dry	31 (135%)	-2 (-4%)
	Critical	22 (367%)	-3 (-10%)
	All	113 (159%)	-13 (-7%)
July	Wet	46 (38%)	5 (3%)
	Above Normal	22 (50%)	2 (3%)
	Below Normal	30 (51%)	2 (2%)
	Dry	43 (61%)	7 (7%)
	Critical	37 (71%)	5 (6%)
	All	178 (51%)	21 (4%)
August	Wet	43 (48%)	10 (8%)
	Above Normal	21 (84%)	3 (7%)
	Below Normal	33 (87%)	4 (6%)
	Dry	44 (110%)	-9 (-10%)
	Critical	36 (86%)	-4 (-5%)
	All	177 (76%)	4 (1%)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because habitat would  
 6 not be substantially reduced. There would be no flow- or temperature-related effects in the  
 7 Sacramento and Feather Rivers and Clear Creek under Alternative 1A relative to NAA.

8 **CEQA Conclusion:** In general, under Alternative 1A water operations, the quantity and quality of  
 9 rearing habitat for fry and juvenile spring-run Chinook salmon would not be affected relative to the  
 10 CEQA baseline.

11 **Sacramento River**

12 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
 13 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
 14 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November  
 15 would be lower by up to 21% under A1A\_LLT than under Existing Conditions. Flows under A1A\_LLT  
 16 during the remaining 4 months of the period would be generally similar to or up to 13% greater  
 17 than those under Existing Conditions.

1 Shasta Reservoir storage volume at the end of May would be similar to Existing Conditions in wet  
2 and, above normal, and below normal water years (up to -4%), but up to 25% lower in the other by  
3 6% to 9% in dry and critical water years, with an overall average of -9% for all years, respectively  
4 (Table 11-1A-10). This indicates that there would be a small to moderate effect of Alternative 1A on  
5 flows during the spawning and egg incubation period.

6 Shasta Reservoir storage volume at the end of September under A1A\_LLT would be 9% to 33%  
7 lower relative to Existing Conditions (Table 11-1A-21).

8 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
9 examined during the November through March spring-run Chinook salmon juvenile rearing period  
10 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
11 *utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean  
12 monthly water temperature between Existing Conditions and Alternative 1A in most months.

13 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under  
14 A1A\_LLT would be similar to Existing Conditions (Table 11-1A-25). The percentage of years with  
15 good (lower) juvenile stranding risk conditions under A1A\_LLT would be 26% lower than under  
16 Existing Conditions.

17 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A1A\_LLT would  
18 be 37% lower than under Existing Conditions.

#### 19 **Clear Creek**

20 Flows in Clear Creek during the November through March period under A1A\_LLT would generally  
21 be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model*  
22 *Results utilized in the Fish Analysis*).

23 Water temperatures were not modeled in Clear Creek.

#### 24 **Feather River**

25 Relatively constant flows in the low flow channel throughout the November through June period  
26 under A1A\_LLT would not differ from those under Existing Conditions. In the high flow channel,  
27 flows under A1A\_LLT would be similar to or greater than flows under Existing Conditions from  
28 November through June with few exceptions during which flows would be up to 40% lower under  
29 A1A\_LLT.

30 May Oroville storage volume under A1A\_LLT would be lower than Existing Conditions by 7% to 15%  
31 depending on water year type, except in wet years, in which storage would be similar to Existing  
32 Conditions (Table 11-1A-30).

33 Oroville Reservoir storage volume at the end of September would be similar under A1A\_LLT relative  
34 to Existing Conditions during dry and critical water years, but moderately lower (up to 21% lower)  
35 for other water year types (Table 11-1A-27).

36 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
37 Thermalito Afterbay (high-flow channel) were evaluated during the November through June  
38 juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
39 *Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 1A

1 would be 5% to 10% greater than those under Existing Conditions during November through March,  
2 but similar (<5% difference) during April through June.

3 The percent of months exceeding the 63°F temperature threshold in the Feather River above  
4 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-1A-  
5 31). The percent of months exceeding the threshold under Alternative 1A would be similar to those  
6 under Existing Conditions during May, but up to 49% greater during June through August.

7 Total degree-days exceeding 63°F were summed by month and water year type above Thermalito  
8 Afterbay (low-flow channel) during May through August (Table 11-1A-32). Total degree-months  
9 under Alternative 1A would be similar to those under Existing Conditions during May, but 51% to  
10 159% higher during June through August.

### 11 **Summary of CEQA Conclusion**

12 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between  
13 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
14 alternative could substantially reduce rearing habitat, contrary to the NEPA conclusion set forth  
15 above. Flows in the Sacramento and Feather Rivers and in Clear Creek would be similar under  
16 Alternative 1A relative to the CEQA baseline, although temperatures and the exceedances above the  
17 temperature thresholds in the Feather River would be substantially higher under Alternative 1A.  
18 SacEFT predicts increased juvenile stranding risk and SALMOD predicts increased habitat-related  
19 mortality in the Sacramento River.

20 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
21 change, future water demands, and implementation of the alternative. The analysis described above  
22 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
23 the alternative from those of sea level rise, climate change and future water demands using the  
24 model simulation results presented in this chapter. However, the increment of change attributable  
25 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
26 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
27 implementation period, which does include future sea level rise, climate change, and water  
28 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
29 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
30 effect of the alternative from those of sea level rise, climate change, and water demands.

31 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
32 term implementation period and Alternative 1A indicates that flows and reservoir storage in the  
33 locations and during the months analyzed above would generally be similar between Existing  
34 Conditions during the LLT and Alternative 1A. This indicates that the differences between Existing  
35 Conditions and Alternative 1A found above would generally be due to climate change, sea level rise,  
36 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
37 1A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
38 therefore would not in itself result in a significant impact on rearing habitat for spring-run Chinook  
39 salmon. This impact is found to be less than significant and no mitigation is required.

1 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
2 **(Spring-Run ESU)**

3 **Upstream of the Delta**

4 In general, Alternative 1A would reduce migration conditions for spring-run Chinook salmon  
5 relative to NAA.

6 ***Sacramento River***

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through  
8 May juvenile Chinook salmon spring-run migration period. Flows under A1A\_LLT during December  
9 through May would always be similar to or greater (up to 16%) than flows under NAA, except for  
10 January in critical years (11% lower)(Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
11 *Analysis*).

12 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
13 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,  
14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
16 NAA and Alternative 1A in any month or water year type throughout the period.

17 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through  
18 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT in April through June would  
20 generally be similar to or greater (up to 14%) than flows under NAA. During July, flows under  
21 A1A\_LLT would generally be similar to flows under NAA. During August, flows under A1A\_LLT  
22 would be lower (up to 19% lower) than flows under NAA.

23 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
24 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
25 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
26 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
27 NAA and Alternative 1A in any month or water year type throughout the period.

28 ***Clear Creek***

29 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
30 migration period under A1A\_LLT would be similar to or greater than flows under NAA (Appendix  
31 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
33 migration period under A1A\_LLT would generally be similar to or greater than flows under NAA  
34 with the exception of critical water years during June in which there would be an 8% reduction in  
35 flows (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Water temperatures were not modeled in Clear Creek.

37 ***Feather River***

38 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
39 November through May juvenile spring-run Chinook salmon migration period (Appendix 11C,

1 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to or  
2 greater than flows under NAA in all months and water years except during November in above  
3 normal years (7% lower) and January in critical years (7% lower).

4 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
5 were examined during the November through May juvenile spring-run Chinook salmon migration  
6 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
7 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
8 temperature between NAA and Alternative 1A in any month or water year type throughout the  
9 period.

10 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
11 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
12 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT during April through  
13 June would generally be greater by up to 44% than flows under NAA, except in critical years during  
14 June (8% lower). Flows under A1A\_LLT during July and August would generally be lower than flows  
15 under NAA by up to 49%.

16 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17 were examined during the April through August adult spring-run Chinook salmon upstream  
18 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
19 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
20 mean monthly water temperature between NAA and Alternative 1A in any month or water year type  
21 throughout the period.

## 22 **Through-Delta**

### 23 ***Juveniles***

24 As discussed for winter-run Chinook above (Impact AQUA-42), Plan Area flows have considerable  
25 importance for downstream migrating juvenile salmonids and would be affected by the north Delta  
26 diversions. Under Alternative 1A, Sacramento River flows below the NDD during the juvenile spring-  
27 run migration period (November-May) would be reduced compared to Existing Conditions  
28 (Appendix 11C). Mean monthly flows under Alternative 1A averaged across years would be lower  
29 (up to 31% lower) compared to NAA. Flows would be up to 39% lower in November of above  
30 normal years. However, *CM1 Water Facilities and Operation* includes bypass flow criteria that will be  
31 managed in real time to minimize adverse effects of diversions at the north Delta intakes on  
32 downstream-migrating salmonids.

33 Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would  
34 be minimal (less than 2% of annual production) (Table 11-1A-17). An assumption of 5% loss per  
35 intake would yield a cumulative loss of 19.2% of spring-run Chinook juveniles that reach the Delta.  
36 This assumption is uncertain and represents an upper bound estimate. In addition, the five intake  
37 structures would permanently displace approximately 22 acres of in-water habitat.

38 Through-Delta survival of migrating juvenile spring-run Chinook salmon, as estimated by DPM,  
39 averaged 29% across all years, 38% in wetter years, and 24% in drier years under Alternative 1A  
40 (Table 11-1A-33). This is similar (<5% difference) to results under baseline conditions (about 1%  
41 lower survival compared to NAA, a 3% relative decrease).

1 **Table 11-1A-33. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**  
2 **under Alternative 1A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A1A_LLT	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wetter Years	42.1	40.4	38.1	-4.0 (-10%)	-2.3 (-6%)
Drier Years	24.8	24.3	24.1	-0.7 (-2%)	-0.2 (0%)
All Years	31.3	30.3	29.3	-1.9 (-5%)	-1.0 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

3

4 **Adults**

5 Adult salmonids migrating through the delta use flow and olfactory cues for navigation to their natal  
6 streams (Marston et al. 2012), as discussed above for winter-run Chinook (Impact AQUA-42). The  
7 importance of flow changes to currently affect these cues is rated as low but with low certainty.  
8 Sacramento River flows downstream of the proposed north Delta intakes generally will be lower  
9 under Alternative 1A operations relative to NAA, with differences between water-year types  
10 because of differences in the relative proportion of water being exported from the north Delta and  
11 south Delta facilities (*Appendix 11C*). During the adult spring-run Chinook salmon upstream  
12 migration from March to June, the proportion of Sacramento River water in the Delta would  
13 decrease 5% to 11% under Alternative 1A compared to NAA (Table 11-1A-34). Adult salmonid  
14 attraction due to olfactory cues could be adversely affected by dilution greater than 20%, but has  
15 not been discernibly affected by dilution of 10% or less (Fretwell 1989). Olfactory cues for adult  
16 spring-run Chinook salmon from the Sacramento River would not substantially affected by flow  
17 operations under Alternative 1A.

18 **Table 11-1A-34. Monthly Average Percentage (%) of Water at Collinsville Originating in the**  
19 **Sacramento River during the March through June Adult Spring-Run Chinook Salmon Migration**  
20 **Period**

Month	EXISTING CONDITIONS	NAA	A1A_LLT	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
March	78	76	67	-11	-9
April	77	75	67	-10	-8
May	69	65	61	-8	-4
June	64	62	59	-5	-3

Shading indicates 10% or greater absolute difference.

Source: DSM2-QUAL fingerprinting analysis (monthly time step, October 1976-September 1991). *BDCP Effects Analysis – Appendix 5.C, Section 5C.5.3. Passage, Movement, and Migration Results.*

21

22 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 1A is adverse due to the  
23 cumulative effects associated with five north Delta intake facilities, including mortality related to

1 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to  
2 reduced flows downstream of the intakes) associated with the five NDD intakes.

3 Upstream of the Delta migration conditions for spring-run Chinook salmon under Alternative 1A  
4 would not be adverse because flow and temperature conditions would generally be similar to those  
5 under the NEPA baseline.

6 Adult attraction flows under Alternative 1A would be lower than those under NAA, but adult  
7 attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

8 Near-field effects of Alternative 1A NDD on spring-run Chinook salmon related to impingement and  
9 predation associated with five new intakes could result in substantial effects on juvenile migrating  
10 spring-run Chinook salmon, although there is high uncertainty regarding the potential effects.  
11 Estimates within the effects analysis range from very low levels of effects (~2% mortality) to very  
12 significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented  
13 with the intent of providing localized and temporary reductions in predation pressure at the NDD.  
14 Additionally, several pre-construction surveys to better understand how to minimize losses  
15 associated with the five new intake structures will be implemented as part of the final NDD screen  
16 design effort. Alternative 1A also includes an Adaptive Management Program and Real-Time  
17 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
18 adequate migration conditions for spring-run Chinook salmon. However, at this time, due to the  
19 absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of  
20 mortality expected from near-field effects at the NDD remains highly uncertain.

21 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
22 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
23 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 1A  
24 predict improvements in smolt condition and survival associated with increased access to the Yolo  
25 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
26 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
27 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

28 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
29 all of these elements of BDCP operations and conservation measures to predict smolt migration  
30 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
31 migration survival under Alternative 1A would be similar to survival rates estimated for NAA.  
32 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
33 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
34 future. These efforts are expected to improve our understanding of the relationships and  
35 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
36 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
37 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
38 1A on spring-run Chinook salmon through-Delta survival remains uncertain.

39 Therefore, primarily as a result of reduced upstream migration habitat conditions for spring-run  
40 Chinook salmon due to unacceptable levels of uncertainty regarding the cumulative impacts of near-  
41 field and far-field effects associated with the presence and operation of the five intakes on spring-  
42 run Chinook salmon, this effect is adverse. While implementation of the conservation and mitigation  
43 measures listed below would address these impacts, these are not anticipated to reduce the impacts  
44 to a level considered not adverse.

1 *CEQA Conclusion:* In general, Alternative 1A would reduce migration conditions for spring-run  
2 Chinook salmon relative to the Existing Conditions.

### 3 **Upstream of the Delta**

#### 4 ***Sacramento River***

5 Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-  
6 run Chinook salmon migration period under A1A\_LLT would generally be similar to or greater than  
7 flows under Existing Conditions except in wet water years during May (14% decrease) (Appendix  
8 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
10 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,  
11 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
12 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
13 Existing Conditions and Alternative 1A in any month or water year type throughout the period.

14 Flows in the Sacramento River upstream of Red Bluff during the April through August adult spring-  
15 run Chinook salmon upstream migration period under A1A\_LLT would generally be similar to flows  
16 under Existing Conditions during April and June, greater than flows under Existing Conditions  
17 during May, and lower than Existing Conditions during July and August.

18 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
19 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
20 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
21 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
22 Existing Conditions and Alternative 1A during April through July. Mean monthly water temperatures  
23 under Alternative 1A would be 7% greater relative to Existing Conditions during August.

#### 24 ***Clear Creek***

25 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
26 migration period under A1A\_LLT would be similar to or greater than flows under Existing  
27 Conditions, with the greatest increases occurring in January, February, and March of wet years (17%  
28 to 54% increases) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
30 migration period under A1A\_LLT would generally be similar to or greater than flows under Existing  
31 Conditions with exceptions during August of critical water years (17% lower) (Appendix 11C,  
32 *CALSIM II Model Results utilized in the Fish Analysis*).

33 Water temperatures were not modeled in Clear Creek.

#### 34 ***Feather River***

35 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
36 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,  
37 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be  
38 greater (up to 37% greater) or similar to those under Existing Conditions, except for below normal  
39 years in November, January and March (11% to 12% lower), and wet years in November and May  
40 (13% and 23% lower, respectively).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
2 were examined during the November through May juvenile spring-run Chinook salmon migration  
3 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
4 *Results utilized in the Fish Analysis*). Water temperatures under Alternative 1A would be 5% greater  
5 than those under Existing Conditions in November and December, but similar during January  
6 through May.

7 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
8 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
9 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April through May under A1A\_LLT  
10 would generally be similar to or greater than flows under Existing Conditions, except in wet years  
11 during May (23% lower). Flows during June, July, and August under A1A\_LLT would generally be up  
12 to 60% lower than flows under Existing Conditions.

13 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
14 were examined during the April through August adult spring-run Chinook salmon upstream  
15 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
16 *Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 1A  
17 would be 6% higher than those under Existing Conditions during July and August, and similar  
18 during April through June.

## 19 **Through-Delta**

### 20 **Juveniles**

21 As discussed for winter-run Chinook above (Impact AQUA-42), Plan Area flows have considerable  
22 importance for downstream migrating juvenile salmonids and would be affected by the north Delta  
23 diversions. Under Alternative 1A, Sacramento River flows below the NDD during the main juvenile  
24 spring-run migration period (November-January) would be reduced compared to Existing  
25 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows  
26 under Alternative 1A averaged across years would be lower (up to 32% lower) compared to Existing  
27 Conditions. Flows would be up to 37% lower in March of above normal and April of below normal  
28 years. Note that *CM1 Water Facilities and Operation* includes bypass flow criteria that will be  
29 managed in real time to minimize adverse effects of diversions at the north Delta intakes on  
30 downstream-migrating salmonids.

31 Potential predation losses at the five north Delta intakes would range from less than 2%  
32 (bioenergetics modeling) to 19% (an upper bound based on 5% loss per intake) of the annual  
33 production that reaches the north Delta. In addition, the five intake structures would permanently  
34 displace approximately 22 acres of in-water habitat.

35 Through-Delta survival of migrating juveniles, as estimated by DPM, averaged 29% across all years,  
36 with greater survival in wetter years (38%) than in drier years (24%) under Alternative 1A.  
37 Compared to Existing Conditions, average juvenile survival would decrease 4% (10% relative  
38 decrease) in wetter years and would be similar to Existing Conditions in drier (3% relative  
39 decrease) and all years combined (6% relative decrease) (Table 11-1A-33).

### 40 **Adults**

41 During the adult spring-run Chinook salmon migration period (March-June), Sacramento River flows  
42 downstream of the proposed north Delta intakes generally will be lower under Alternative 1A

1 operations compared to Existing Conditions, with differences between water-year types because of  
 2 differences in the relative proportion of water being exported from the north Delta and south Delta  
 3 facilities (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The proportion of  
 4 Sacramento River water in the Delta would decline 5% to 11% compared to Existing Conditions  
 5 (Table 11-1A-34); this change in olfactory cues is not expected to appreciably affect migrating  
 6 adults.

7 **Summary of CEQA Conclusion**

8 Overall, the results indicate that the effect of Alternative 1A is significant because it has the potential  
 9 to substantially decrease spring-run Chinook salmon migration habitat conditions. Upstream of the  
 10 Delta, migration conditions would generally be similar to those under Existing Conditions, except in  
 11 the Feather River, in which flows would be up to 60% lower during the majority of the adult  
 12 upstream migration period. Survival of juveniles migrating through the Delta is expected to be  
 13 similar or slightly lower in wetter years compared to Existing Conditions, but estimated predation  
 14 losses past the five NDD intakes could hypothetically range from 2% to 19%. In general, the impact  
 15 on emigrating juveniles would be significant due to the impacts associated with predation and  
 16 habitat loss from the five intakes (similar to the previous description under Impact AQUA-42).  
 17 Implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce  
 18 them to a level considered less than significant. Although implementation of *CM6 Channel Margin*  
 19 *Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be  
 20 located near the intakes and therefore would not fully compensate for the lost habitat. Additionally,  
 21 implementation of this measure would not fully address predation losses. *CM15 Localized Reduction*  
 22 *of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness  
 23 such that it is considered to have no demonstrable effect. Conservation measures that address  
 24 habitat and predation losses, therefore, would potentially minimize impacts to some extent but not  
 25 to a less than significant level. Consequently, as a result of these changes in migration conditions,  
 26 this impact is significant and unavoidable.

27 Applicable conservation measures are briefly described below and full descriptions are found in  
 28 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
 29 Reduction of Predatory Fishes (Predator Control) (CM15).

30 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
 31 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
 32 habitats on the waterside side of levees along channels that provide rearing and outmigration  
 33 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
 34 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
 35 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
 36 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
 37 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
 38 margin enhancement would be performed only along channels that provide rearing and  
 39 outmigration habitat for juvenile salmonids. These include channels that are protected by  
 40 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
 41 among several others.

42 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
 43 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
 44 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
 45 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are

1 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
2 Therefore, this conservation measure is not intended to entirely remove predators at any  
3 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
4 conservation measure would also not remove piscivorous birds. Because of uncertainties  
5 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
6 projects and research actions coupled with an adaptive management and monitoring program to  
7 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
8 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
9 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

10 This impact is a result of the specific reservoir operations and resulting flows associated with this  
11 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
12 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
13 change the alternative, thereby making it a different alternative than that which has been modeled  
14 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
15 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
16 severity of the impact though not necessarily to a less-than-significant level.

17 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**  
18 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
19 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

20 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
21 significant and unavoidable adverse effects on migration habitat, this conclusion was based on  
22 the best available scientific information at the time and may prove to have been over- or  
23 understated. Upon the commencement of operations of CM1 and continuing through the life of  
24 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
25 whether such effects would be as extensive as concluded at the time of preparation of this  
26 document and to determine any potentially feasible means of reducing the severity of such  
27 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
28 consistent with the operational framework for Alternative 1A.

29 The development and implementation of any mitigation actions shall be focused on those  
30 incremental effects attributable to implementation of Alternative 1A operations only.  
31 Development of mitigation actions for the incremental impact on migration habitat attributable  
32 to climate change/sea level rise are not required because these changed conditions would occur  
33 with or without implementation of Alternative 1A.

34 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**  
35 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

36 Following commencement of initial operations of CM1 and continuing through the life of the  
37 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
38 modified operations could reduce impacts to migration habitat under Alternative 1A. The  
39 analysis required under this measure may be conducted as a part of the Adaptive Management  
40 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

1           **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**  
2           **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**  
3           **Conditions Consistent with CM1**

4           In order to determine the feasibility of reducing the effects of CM1 operations on spring-run  
5           Chinook salmon habitat, the BDCP proponents will consult with FWS and the Department of Fish  
6           and Wildlife to identify and implement any feasible operational means to minimize effects on  
7           migration habitat. Any such action will be developed in conjunction with the ongoing monitoring  
8           and evaluation of habitat conditions required by Mitigation Measure AQUA-60a.

9           If feasible means are identified to reduce impacts on migration habitat consistent with the  
10          overall operational framework of Alternative 1A without causing new significant adverse  
11          impacts on other covered species, such means shall be implemented. If sufficient operational  
12          flexibility to reduce effects on spring-run Chinook salmon habitat is not feasible under  
13          Alternative 1A operations, achieving further impact reduction pursuant to this mitigation  
14          measure would not be feasible under this Alternative, and the impact on spring-run Chinook  
15          salmon would remain significant and unavoidable.

16          **Restoration Measures (CM2, CM4–CM7, and CM10)**

17          **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**  
18          **(Spring-Run ESU)**

19          Please refer to Impact AQUA-43 for winter-run Chinook salmon.

20          **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**  
21          **Salmon (Spring-Run ESU)**

22          Please refer to Impact AQUA-44 for winter-run Chinook salmon.

23          **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

24          Please refer to Impact AQUA-45 for winter-run Chinook salmon.

25          **Other Conservation Measures (CM12–CM19 and CM21)**

26          **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
27          **ESU) (CM12)**

28          Please refer to Impact AQUA-46 for winter-run Chinook salmon.

29          **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
30          **(Spring-Run ESU) (CM13)**

31          Please refer to Impact AQUA-47 for winter-run Chinook salmon.

32          **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
33          **Run ESU) (CM14)**

34          **NEPA Effects:** As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very  
35          similar to Existing Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP  
36          export service areas (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14*

1 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would increase the dissolved  
2 oxygen levels in the Stockton Deep Water Ship Channel. Spring-run Chinook salmon occupy the  
3 channel for periods of time. The effect would be beneficial.

4 **CEQA Conclusion:** *CM14 Stockton Deepwater Ship Channel Dissolved Oxygen Levels* would increase  
5 dissolved oxygen levels in the Stockton Deepwater Ship Channel. Spring-run Chinook salmon occupy  
6 the channel for periods of time. Implementation of *CM14 Stockton Deepwater Ship Channel Dissolved*  
7 *Oxygen Levels* would improve the habitat conditions for spring-run Chinook during the periods they  
8 occupy the channel. The impact would be beneficial because it would improve habitat conditions.  
9 Consequently, no mitigation would be required.

10 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
11 **(Spring-Run ESU) (CM15)**

12 Please refer to Impact AQUA-49 for winter-run Chinook salmon.

13 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
14 **(CM16)**

15 Please refer to Impact AQUA-50 for winter-run Chinook salmon.

16 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
17 **(CM17)**

18 Please refer to Impact AQUA-51 for winter-run Chinook salmon.

19 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
20 **(CM18)**

21 Please refer to Impact AQUA-52 for winter-run Chinook salmon.

22 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
23 **ESU) (CM19)**

24 Please refer to Impact AQUA-53 for winter-run Chinook salmon.

25 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
26 **(Spring-Run ESU) (CM21)**

27 Please refer to Impact AQUA-54 for winter-run Chinook salmon.

28 **Fall-/Late Fall–Run Chinook Salmon**

29 **Construction and Maintenance of CM1**

30 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
31 **(Fall-/Late Fall–Run ESU)**

32 ***Temporary Increases in Turbidity***

33 Effects on fall-run and late fall–run Chinook salmon from temporary increases in turbidity during  
34 construction would be similar to those described for winter-run Chinook salmon (see Impact AQUA-

1 37 for winter-run Chinook salmon). Effects would be avoided and minimized through timing  
2 restrictions and by implementing the environmental commitments *Environmental Training*;  
3 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
4 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; *Disposal of Spoils*,  
5 *Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan* (see Appendix 3B,  
6 *Environmental Commitments* and Impact AQUA-1 for delta smelt for details of these plans).

### 7 ***Accidental Spills***

8 Effects on fall-run and late fall-run Chinook salmon from accidental spills during construction would  
9 be similar to those described for winter-run Chinook salmon (see Impact AQUA-37 for winter-run  
10 Chinook salmon). Effects would be minimized by implementing the environmental commitments  
11 described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*  
12 (*Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*;  
13 *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*),  
14 specifically the *Spill Prevention, Containment, and Countermeasure Plan*.

### 15 ***Disturbance of Contaminated Sediments***

16 Potential effects on fall-run and late fall-run Chinook salmon from disturbance of contaminated  
17 sediments during construction are similar to those described for winter-run Chinook salmon (see  
18 Impact AQUA-37 for winter-run Chinook salmon).

### 19 ***Underwater Noise***

20 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
21 fish, including Chinook salmon (see Impact AQUA-1). Table 11-4 illustrates the species and life  
22 stages of Chinook salmon expected to be present in the north, east, and south Delta during the  
23 expected in-water construction window (June 1–October 31). Winter-run, spring-run, fall-run, and  
24 late fall-run Chinook salmon eggs and fry would not experience underwater sound because the  
25 locations of the intakes and barge landings are not considered suitable habitat for these two life  
26 stages of this species, and they would not be present during the in-water construction period  
27 (typically June to October). Therefore, these life history stages would not be affected.

28 Adult fall-run Chinook salmon are expected to be semi-abundant to abundant near the construction  
29 areas of the intakes and barge landings in September and October. Juvenile fall-run Chinook salmon  
30 have a low to moderate potential to occur near the intakes during pile driving in June through  
31 October, and near the barge landings in June to September. Individual fish exposed to sound  
32 pressure levels in excess of 187 dB SEL<sub>cumulative</sub> would be expected to experience the onset of  
33 physical injury. The probability of exposure in excess of this threshold is limited by the fact that the  
34 amount impact pile driving and the duration of pile driving during any one day will be minimized to  
35 the extent practicable. In addition, Sacramento River fall-run Chinook salmon are typified by an  
36 ocean-type life history, meaning that they enter freshwater close to maturity and migrate rapidly to  
37 spawning habitats (Healy 1991). As such, fall-run Chinook salmon would be expected to migrate  
38 through the construction zone quickly, which would limit exposure to cumulative SEL levels.

39 Adult late fall-run Chinook salmon would not occur near the intakes or barge landings during the in-  
40 water construction period. In-water work will take place from June to October. Adult late fall-run  
41 Chinook do not commonly enter the lower Sacramento River before November and have completed  
42 their upstream migration by May. Juvenile late fall-run Chinook salmon are present in the

1 Sacramento River and the Delta between June and October, but are typically present at such low  
2 abundance that the probability of occurrence in proximity to active construction at the intake and  
3 barge landing sites would be limited. However, individuals occurring in proximity to construction  
4 would be exposed to underwater noise impacts.

5 Table 11-8 illustrates the estimated area where the cumulative SEL threshold would be exceeded if  
6 impact pile driving is required during construction. All juveniles exposed to underwater noise would  
7 be expected to be larger than the 2-gram size threshold, based on the typical length at age and the  
8 length to weight relationship observed for Chinook salmon occurring in the Delta (Myers et al. 1998;  
9 Kimmerer et al. 2005). On this basis, juveniles exposed to underwater noise in excess of 187 dB  
10 SEL<sub>cumulative</sub> would be expected to experience injury-level adverse effects. These effects would be  
11 avoided and minimized through implementation of Mitigation Measures AQUA-1a and/or AQUA-1b.

### 12 ***Fish Stranding***

13 Juvenile fall-run Chinook salmon could be present in the vicinity of intake construction on the  
14 Sacramento River during the period when cofferdams are installed to isolate work areas. This  
15 presents the potential for entrapment within the isolated work areas and the subsequent exposure  
16 to injury or mortality from capture stranding stress during removal, or incidental stranding during  
17 work area dewatering. The risk of fish entrapment and subsequent handling stress during removal  
18 would be minimized by limiting cofferdam construction and other in-water work to the CDFW- and  
19 NMFS- approved in-water work windows (expected to be June 1 through October 31). Adverse  
20 effects would also be minimized through the implementation of environmental commitment *Fish*  
21 *Rescue and Salvage Plan* (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental*  
22 *Commitments*). However, the potential for individual juvenile fall-run Chinook salmon to experience  
23 adverse effects from incidental entrapment cannot be discounted, such effects are not expected to  
24 adversely affect the overall population.

### 25 ***In-Water Work Activities***

26 Effects on fall-run and late-fall-run Chinook salmon from in-water work activities during  
27 construction would be similar to those described for winter-run Chinook salmon (see Impact AQUA-  
28 37 for winter-run Chinook salmon).

### 29 ***Loss of Spawning, Rearing, or Migration Habitat***

30 Effects on fall-run and late-fall-run Chinook salmon from loss of spawning, rearing or migration  
31 habitat during construction would be similar to those described for winter-run Chinook salmon (see  
32 Impact AQUA-37 for winter-run Chinook salmon).

### 33 ***Predation***

34 Effects on fall-run and late-fall-run Chinook salmon from predation during construction would be  
35 similar to those described for winter-run Chinook salmon (see Impact AQUA-37 for winter-run  
36 Chinook salmon).

### 37 ***Summary***

38 Construction of Alternative 1A involves several elements with the potential to cause adverse effects  
39 on individual fall-run and late-fall-run Chinook salmon. However, these effects will be avoided  
40 and/or minimized in most cases through implementation of environmental commitments and

1 conservation measures, such that adverse population effects would not be expected to occur.  
2 Construction-related turbidity and underwater noise associated with impact pile driving are the  
3 most geographically extensive potential effects, with underwater noise having the greatest potential  
4 for adverse effects on Chinook salmon.

5 The majority of potential construction-related adverse effects will be avoided and minimized by  
6 construction timing. Adhering to the in-water work window will minimize Chinook salmon exposure  
7 to water quality and disturbance related stressors by limiting in-water construction activities to a  
8 time period when Chinook salmon are least likely to be present in the vicinity. In addition, several  
9 environmental commitments will be implemented that will avoid and minimize adverse effects by  
10 controlling the duration and magnitude of construction related impacts (see Impact AQUA-1 for  
11 delta smelt and Appendix 3B, *Environmental Commitments*). These include *Environmental Training*;  
12 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
13 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; *Disposal of Spoils,*  
14 *Reusable Tunnel Material, and Dredged Material*; and development and implementation of a barge  
15 operations plan (see *Barge Operations Plan*) designed to avoid turbidity generation and shoreline  
16 erosion from propeller wash and vessel wakes. These timing restrictions and environmental  
17 commitments are expected to avoid adverse effects on Chinook salmon from construction-related  
18 turbidity, accidental spills, and re-suspension and redistribution of potentially contaminated  
19 sediments.

20 Underwater noise associated with pile driving has the greatest potential for adverse effects on  
21 Chinook salmon, with adult fall-run Chinook having the greatest likelihood of exposure. However,  
22 the migration timing of spring- and winter-run Chinook salmon also overlaps a portion of the  
23 expected in-water work window, and could be affected by pile driving activities. In general, timing  
24 restrictions would limit pile driving to periods when Chinook salmon are least likely to be present in  
25 the vicinity of planned activities. Adult Chinook would also be migrating rapidly through the Delta  
26 and the Sacramento River when pile driving activities could be taking place, meaning that the  
27 opportunity for cumulative SEL exposure would be limited and exceedances of the cumulative  
28 exposure criterion are unlikely. They may experience short delays in migration past the intakes  
29 when pile driving is occurring; however, pile driving would occur only intermittently through a  
30 portion of the day, and minor migration delays would be unlikely affect their ability to successfully  
31 reach spawning grounds. These adverse effects would be further avoided and minimized by  
32 restricting impact pile driving to the minimum amount required for construction, and through  
33 implementation of the avoidance and minimization measures included in Mitigation Measures  
34 AQUA-1a and AQUA-1b. Chinook salmon migratory behavior would also be expected to limit the  
35 likelihood of adverse effects, as upstream migrants are likely to be moving quickly through the Delta  
36 and lower Sacramento River, thereby reducing the number of fish occurring in the construction area  
37 during pile driving periods. This migration behavior would also reduce the effects of cumulative  
38 exposure associated with multiple pile strikes.

39 Therefore, the potential for Chinook salmon to experience an adverse effect (e.g., injury or mortality,  
40 or migratory disturbance) would be low because of the potentially low to moderate temporal and  
41 spatial migration distribution around the intake and barge facility construction areas during the in-  
42 water construction window.

43 The likelihood of juvenile fall- and late fall-run Chinook salmon being in the vicinity when impact  
44 driving could take place is low. In addition to their timing in the Delta, the habitat at the intake and  
45 barge landing locations is considered poor because of relatively steep rip rap banks and deep

1 channels with little refuge, which may further limit the overall abundance of juvenile Chinook  
2 salmon. Therefore, the potential for juvenile fall- and late fall-run Chinook salmon to experience an  
3 adverse effect (e.g., injury or mortality, or migratory disturbance) would be low because of their low  
4 temporal and spatial migration distribution around the intake and barge facility construction areas,  
5 and the intermittent nature of potential exposure above the threshold criterion. While underwater  
6 noise from impact pile driving could affect individual Chinook salmon, the effect would not  
7 adversely affect Chinook salmon populations. Thus, the effect would not be adverse.

8 Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge Operations*  
9 *Plan* (as described under Impact AQUA-1 for delta smelt and in Appendix 3B) would also offset  
10 potential effects of construction activities on Chinook salmon. Construction of the approach canal  
11 and Byron Tract Forebay would not affect fish-accessible waterways and therefore would not affect  
12 Chinook salmon. As a result, these construction activities would not result in adverse effects on  
13 Chinook salmon populations.

14 The construction of the intakes and barge landings will temporarily affect rearing and migration  
15 habitat, and the intakes screens will permanently alter habitat in the Sacramento River. Despite the  
16 relatively poor quality of the current habitat, it is designated critical habitat for Chinook salmon.  
17 However, implementation of *CM6 Channel Margin Enhancement* would enhance channel margin  
18 habitat along 20 miles of the Sacramento River, including the vicinity of the intake structures, and  
19 would be designed to result in a net improvement in channel margin habitat function. Therefore, the  
20 temporary and permanent effects on rearing and migration habitat would not adversely affect  
21 Chinook salmon populations.

22 **NEPA Effects:** The effects would not be adverse for fall-run/late fall-run Chinook salmon.

23 **CEQA Conclusion:** The potential impact on Chinook salmon from construction activities would be  
24 considered less than significant due to implementation of the environmental commitments  
25 described in Appendix 3B, *Environmental Commitments*; these are *Environmental Training*;  
26 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
27 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; *Disposal of Spoils*;  
28 *Reusable Tunnel Material*, and *Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations*  
29 *Plan*. Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt. These  
30 measures would be expected to protect Chinook salmon from any adverse water quality effect  
31 (turbidity and spills of hazardous materials) resulting from project construction. Construction  
32 would not be expected to increase predation rates relative to Existing Conditions. Construction  
33 associated with Alternative 1A will result in both temporary and permanent alteration of rearing  
34 and migratory habitats used by Chinook salmon. However, these impacts are not expected to be  
35 significant because the loss of habitat is not substantial compared to the amount of habitat currently  
36 available in combination with the amount of new habitat that would result from restoration. The  
37 direct effects of underwater construction noise on Chinook salmon would be a significant impact  
38 because of the high likelihood that it would cause injury or death to most impacted fish in the  
39 immediate vicinity of the activity. However, implementation of Mitigation Measures AQUA-1a and  
40 AQUA-1b would minimize the potential effects from underwater noise and would reduce the  
41 severity of impacts to a less-than-significant level.

42 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
43 **of Pile Driving and Other Construction-Related Underwater Noise**

44 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

4           **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
5           **(Fall-/Late Fall-Run ESU)**

6           ***Temporary Increases in Turbidity***

7           Effects on fall-run and late-fall-run Chinook salmon from temporary increases in turbidity during  
8           construction would be similar to those described for winter-run Chinook salmon (see Impact AQUA-  
9           38 for winter-run Chinook salmon). Effects would also be minimized by implementing the  
10          environmental commitments described in Appendix 3B, *Environmental Commitments*  
11          (*Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
12          *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;*  
13          *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and*  
14          *Barge Operations Plan*). Pertinent details of these plans are provided under Impact AQUA-1 for delta  
15          smelt.

16          ***Accidental Spills***

17          Effects on fall-run and late-fall-run Chinook salmon from accidental spills would be similar to those  
18          described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook salmon).  
19          Effects would be minimized by implementing the environmental commitments in Appendix 3B,  
20          *Environmental Commitments*. These environmental commitments include *Environmental Training;*  
21          *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
22          *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils,*  
23          *Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan*. Pertinent details of  
24          these plans are provided under Impact AQUA-1 for delta smelt.

25          ***Underwater Noise***

26          Effects on fall-run and late-fall-run Chinook salmon from underwater noise would be similar to  
27          those described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook  
28          salmon).

29          ***Maintenance-Related Disturbance***

30          Effects on fall-run and late-fall-run Chinook salmon from in-water work activities would be similar  
31          to those described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook  
32          salmon). Effects would be minimized through timing restrictions and by implementing  
33          environmental commitments including *Environmental Training; Stormwater Pollution Prevention*  
34          *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
35          *Containment, and Countermeasure Plan; and Barge Operations Plan*, described under Impact AQUA-1  
36          for delta smelt and in Appendix 3B, *Environmental Commitments*.

37          ***Loss of Spawning, Rearing, or Migration Habitat***

38          Effects on fall-run and late-fall-run Chinook salmon from loss of spawning, rearing or migration  
39          habitat would be similar to those described for winter-run Chinook salmon (see Impact AQUA-38 for

1 winter-run Chinook salmon). Potential effects would be minimized by implementation of  
2 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
3 *Environmental Commitments*.

#### 4 **Predation**

5 Effects on fall-run and late-fall Chinook salmon from predation during construction would be similar  
6 to those described for winter-run Chinook salmon (see Impact AQUA-38 for winter-run Chinook  
7 salmon).

#### 8 **Summary**

9 In-water maintenance activities would be scheduled to occur when the least numbers of Chinook  
10 salmon would be present in or near the maintenance areas. Such activities would include  
11 maintenance dredging at the intake sites, and installation or repair of riprap bank armoring.  
12 Implementation of the environmental commitments described in Appendix 3B, *Environmental*  
13 *Commitments*, would further minimize or eliminate effects on Chinook salmon. These  
14 environmental commitments include *Environmental Training; Stormwater Pollution Prevention*  
15 *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
16 *Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and*  
17 *Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1 for delta  
18 smelt.

19 Implementation of these environmental commitments, along with the low numbers of Chinook  
20 salmon expected to occur in the maintenance areas during the approved in-water work windows  
21 and the limited frequency and duration of in-water maintenance activities, would result in a very  
22 low potential for adverse effects on Chinook salmon from increased turbidity or spills of hazardous  
23 materials. In addition, no spawning habitat occurs in the areas potentially affected by maintenance  
24 activities, and ample rearing, and migration habitat of the same quality is readily accessible in the  
25 area, and this habitat would not be affected by maintenance activities.

26 **NEPA Effects:** As a result, the short-term maintenance activities would not adversely affect Chinook  
27 salmon populations.

28 **CEQA Conclusion:** In addition to the limited frequency and duration of in-water maintenance  
29 activities, implementation of the environmental commitments identified above and described in  
30 detail under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*, would  
31 minimize the potential for maintenance activities to affect Chinook salmon increased turbidity or  
32 spills of hazardous materials. These environmental commitments described in greater detail under  
33 Impact AQUA-1 for delta smelt, include *Environmental Training; Stormwater Pollution Prevention*  
34 *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
35 *Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and*  
36 *Dredged Material*. Potential changes to rearing and migratory habitat would also be limited and  
37 temporary. Therefore, the potential impact of maintenance activities is considered less than  
38 significant because it would not substantially reduce Chinook salmon habitat, restrict its range, or  
39 interfere with its movement. Consequently, no mitigation would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
3 **Fall-Run ESU))**

4 ***Water Exports from SWP/CVP South Delta Facilities***

5 As noted above for spring-run Chinook salmon juveniles (Impact AQUA-57), the seasonal  
6 entrainment pattern is the best index of entrainment—as opposed to the actual numbers of fish  
7 salvaged—because of the overlap between fall-run and spring-run juvenile Chinook salmon and the  
8 length-at-date criteria used to characterize race. Entrainment loss of fall-run Chinook salmon peaks  
9 in May at both the SWP and CVP facilities, with a second almost as large peak in February at the CVP  
10 facility.

11 Under Alternative 1A, average entrainment, as estimated by the salvage density method across all  
12 years, would decrease 27% for fall-run and decrease 37% for late fall-run Chinook salmon  
13 compared to NAA (Table 11-1A-35). When examining individual water year types, fall-run  
14 entrainment would decrease in wet (70% lower) and above normal (17% lower) years, but increase  
15 in below normal (7% increase) and dry years (30% increase). The reduction was driven largely by a  
16 shift in export pumping to the north Delta intakes in wet years. Since recruitment levels may be  
17 lower in drier years, increases in entrainment during these periods may be an important stressor on  
18 the population. Entrainment of late fall-run Chinook salmon would decrease under Alternative 1A  
19 for all water year types except dry years, when entrainment would increase 6%.

20 Under the assumption that the annual number of juvenile fall-run Chinook salmon juveniles  
21 approaching the Delta was 23 million fish, the percentage of the population lost to entrainment  
22 across all years averaged 0.24% under baseline and decreased slightly to 0.17–0.20% under  
23 Alternative 1A. However, increased entrainment during drier years may have a population-level  
24 impact since recruitment levels are lower during these years.

1 **Table 11-1A-35. Juvenile Fall-Run and Late Fall-Run Chinook Salmon Annual Entrainment Index<sup>a</sup> at**  
 2 **the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 1A**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>Fall-Run Chinook Salmon</b>		
Wet	-89,431 (-70%)	-89,608 (-70%)
Above Normal	-5,259 (-16%)	-5,733 (-17%)
Below Normal	1,313 (10%)	953 (7%)
Dry	7,992 (41%)	6,345 (30%)
Critical	-8,458 (-21%)	-3,280 (-9%)
All Years	-14,988 (-27%)	-15,044 (-27%)
<b>Late Fall-Run Chinook Salmon</b>		
Wet	-3,809 (-64%)	-3,722 (-63%)
Above Normal	-221 (-38%)	-207 (-37%)
Below Normal	-14 (-25%)	-11 (-20%)
Dry	-9 (-7%)	7 (6%)
Critical	-44 (-27%)	-31 (-20%)
All Years	-773 (-40%)	-692 (-37%)

Shading indicates 10% or greater increased entrainment.

Note: Estimated annual index of fish lost, based on normalized salvage data.

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 Potential entrainment at the north Delta intakes occurs only under the action alternatives, including  
 6 Alternative 1A, because there are no north Delta intakes operational under NAA. The north Delta  
 7 intakes would be screened to exclude juvenile fish, including fall-run and late fall-run Chinook  
 8 salmon, and are expected to be effective at excluding fish greater than 15mm long. The effects would  
 9 be minimal, the same as described for Impact AQUA-39 for Alternative 1A.

10 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

11 The effects would be the same as described for Impact AQUA-39 for Alternative 1A. Entrainment and  
 12 impingement effects on fall-run and late fall-run Chinook salmon juveniles would be minimal  
 13 because intakes would have state-of-the-art screens installed.

14 **NEPA Effects:** In conclusion, Alternative 1A would reduce overall entrainment at the south Delta  
 15 facilities, and would have minimal entrainment effects at other diversions due to screens. Therefore,  
 16 the effects would not be adverse for fall-run or late fall-run Chinook salmon.

17 **CEQA Conclusion:** Entrainment at the south Delta facilities would decrease under Alternative 1A  
 18 across all years for fall-run Chinook salmon (27% decrease) and late fall-run Chinook salmon (40%  
 19 decrease) compared to Existing Conditions. Relative reduction in entrainment was greatest in wet  
 20 years (64% to 70% decreased entrainment), when more export pumping shifts to the north Delta  
 21 intakes. Entrainment of fall-run Chinook salmon increased, however, in below normal (10%  
 22 increase) and dry (41% increase) water years. However, increased entrainment during drier years  
 23 may have a population-level impact on fall-run Chinook salmon since recruitment levels are lower  
 24 during these years. In general, potential impacts of Alternative 1A water operations on entrainment

1 of juvenile Chinook salmon (fall-/late fall-run ESU) would be beneficial due to an overall reduction  
2 in entrainment which is beneficial to the population. As with fall-run Chinook, increased  
3 entrainment during drier years may have a population-level impact on late fall-run Chinook salmon  
4 since recruitment levels are lower during these years.

### 5 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 6 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

7 In general, Alternative 1A would not affect the quantity and quality of spawning and egg incubation  
8 habitat for fall-/late fall-run Chinook salmon relative to NAA.

#### 9 ***Sacramento River***

##### 10 *Fall-Run*

11 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-  
12 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
13 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to flows under NAA during  
14 December and January with the exception of January of critical years (11% lower). Flows under  
15 A1A\_LLT during October would be 12% to 33% greater than flows under NAA, and flows under  
16 A1A\_LLT during November would be 9% to 30% lower than flows under NAA.

17 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning  
18 and egg incubation period. End of September Shasta Reservoir storage would be greater than  
19 storage under NAA in wet (8% higher) and above normal (5% higher) water years, 9% lower than  
20 storage under NAA in below water years, and similar to storage under NAA in dry and critical water  
21 years (Table 11-1A-21).

22 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
23 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
24 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
25 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
26 between NAA and Alternative 1A in any month or water year type throughout the period.

27 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
28 increments was determined for each month during October through April and year of the 82-year  
29 modeling period (Table 11-1A-11). The combination of number of days and degrees above the 56°F  
30 threshold were further assigned a “level of concern”, as defined in Table 11-1A-12. Differences  
31 between baselines and Alternative 1A in the highest level of concern across all months and all 82  
32 modeled years are presented in Table 11-1A-22. There would be 6 (14%) and 4 (50%) fewer years  
33 with a “red” and “yellow” level of concern, respectively, under Alternative 1A. The level of concern in  
34 these years would be reduced to an “orange” level (from “red”) or no (from “yellow”) level.

35 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
36 October through April. Total degree-days under Alternative 1A would be 17% higher than those  
37 under NAA during November, 13% lower during April, and similar during remaining months (Table  
38 11-1A-23).

39 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
40 Sacramento River under A1A\_LLT would be lower than or similar to mortality under NAA in all  
41 water year types, including above normal (5% greater relative to NAA, but absolute increase of 1%

of fall-run population) and below normal years (19% greater relative to NAA, but absolute increase of 4% of fall-run population) (Table 11-1A-36). These results indicate that climate change would increase fall-run Chinook salmon egg mortality, but Alternative 1A would have negligible effects.

**Table 11-1A-36. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	10 (105%)	0.6 (3%)
Above Normal	12 (111%)	1 (5%)
Below Normal	15 (144%)	4 (19%)
Dry	18 (120%)	0.8 (3%)
Critical	9 (30%)	-0.8 (-2%)
All	13 (92%)	1 (4%)

SacEFT predicts that there would be a 23% increase in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A1A\_LLT relative to NAA (Table 11-1A-37). SacEFT predicts that there would be a 4% increase in the percentage of years with good (lower) redd scour risk under A1A\_LLT relative to NAA. SacEFT predicts that there would be a 1% decrease in the percentage of years with good (lower) egg incubation conditions between A1A\_LLT and NAA. SacEFT predicts that there would be a 7% increase in the percentage of years with good (lower) redd dewatering risk under A1A\_LLT relative to NAA.

**Table 11-1A-37. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Spawning WUA	-5 (-10%)	8 (23%)
Redd Scour Risk	8 (13%)	3 (4%)
Egg Incubation	-26 (-28%)	-1 (-1%)
Redd Dewatering Risk	2 (7%)	2 (7%)
Juvenile Rearing WUA	1 (3%)	-6 (-15%)
Juvenile Stranding Risk	-3 (-10%)	8 (40%)

WUA = Weighted Usable Area.

*Late Fall-Run*

Sacramento River flows upstream of Red Bluff were examined for the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to or up to 14% greater than flows under NAA throughout the period.

Shasta Reservoir storage at the end of September would affect flows during the late fall-run spawning and egg incubation period. End of September Shasta Reservoir storage would be greater than storage under NAA in wet (8% higher) and above normal (5% higher) water years, 9% lower than storage under NAA in below water years, and similar to storage under NAA in dry and critical water years (Table 11-1A-21). The Reclamation egg mortality model predicts that late fall-run

1 Chinook salmon egg mortality in the Sacramento River under A1A\_LLT would be similar to or less  
2 than the mortality under NAA in all water years, although there would be up to a 21% relative  
3 decrease (in dry years), the absolute decrease would be 2% of the late fall-run population (Table 11-  
4 1A-38).

5 **Table 11-1A-38. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook**  
6 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	3 (167%)	-1 (-13%)
Above Normal	4 (154%)	-1 (-11%)
Below Normal	5 (328%)	1 (15%)
Dry	3 (124%)	-2 (-21%)
Critical	3 (129%)	-0.3 (-6%)
All	4 (168%)	-1 (-10%)

7

8 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
9 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix  
10 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
11 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
12 between NAA and Alternative 1A in any month or water year type throughout the period.

13 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
14 increments was determined for each month during October through April and year of the 82-year  
15 modeling period (Table 11-1A-11). The combination of number of days and degrees above the 56°F  
16 threshold were further assigned a “level of concern”, as defined in Table 11-1A-12. Differences  
17 between baselines and Alternative 1A in the highest level of concern across all months and all 82  
18 modeled years are presented in Table 11-1A-22. There would be 6 (14%) and 4 (50%) fewer years  
19 with a “red” and “yellow” level of concern, respectively, under Alternative 1A. The level of concern in  
20 these years would be reduced to an “orange” level (from “red”) or no (from “yellow”) level.

21 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
22 October through April. Total degree-days under Alternative 1A would be 17% higher than those  
23 under NAA during November, 13% lower during April, and similar during remaining months (Table  
24 11-1A-23).

25 SacEFT predicts that there would be a 10% decrease in the percentage of years with good spawning  
26 availability for late fall–run Chinook salmon, measured as weighted usable area, under A1A\_LLT  
27 relative to NAA (Table 11-1A-39). On an absolute scale (5% reduction), this effect is considered  
28 small. SacEFT predicts that there would be a negligible (<5%) difference in the percentage of years  
29 with good (lower) redd scour risk, egg incubation conditions and redd dewatering risk between  
30 A1A\_LLT and NAA.

**Table 11-1A-39. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Spawning WUA	-9 (-17%)	-5 (-10%)
Redd Scour Risk	-5 (-6%)	1 (1%)
Egg Incubation	-2 (-2%)	-2 (-2%)
Redd Dewatering Risk	-7 (-11%)	-2 (-4%)
Juvenile Rearing WUA	-8 (-18%)	-26 (-41%)
Juvenile Stranding Risk	-26 (-36%)	0 (0%)

WUA = Weighted Usable Area.

**Clear Creek**

No water temperature modeling was conducted in Clear Creek.

**Fall-Run**

Clear Creek flows below Whiskeytown Reservoir were examined for the September through February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to or greater than flows under NAA in all water year types.

The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of flow reduction each month over the incubation period compared to the flow in September when spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during September through February under A1A\_LLT would be the same as the reduction under NAA for all water year types (Table 11-1A-40).

**Table 11-1A-40. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through February Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

1       **Feather River**

2       *Fall-Run*

3       Flows in the Feather River in the low flow and high flow channels were examined for the October  
4       through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,  
5       *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A1A\_LLT  
6       would be identical to those under NAA. Flows in the high-flow channel under A1A\_LLT generally be  
7       similar to or greater than those under NAA, except in above normal years during November and in  
8       critical years during January (10% to 15% lower, respectively).

9       The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
10       comparing the magnitude of flow reduction each month over the incubation period compared to the  
11       flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during  
12       November through January were identical between A1A\_LLT and NAA (Appendix 11C, *CALSIM II*  
13       *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 1A on  
14       redd dewatering in the Feather River low-flow channel.

15       Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
16       channel) and below Thermalito Afterbay (high-flow channel) were examined during the October  
17       through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,  
18       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
19       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
20       NAA and Alternative 1A in any month or water year type throughout the period at either location.

21       The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley  
22       was evaluated during October through April (Table 11-1A-41). The percent of months exceeding the  
23       threshold under Alternative 1A would similar to or up to 20% lower (absolute scale) than the  
24       percent under NAA.

1 **Table 11-1A-41. Differences between Baseline and Alternative 1A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LLT</b>					
October	2 (3%)	12 (14%)	19 (25%)	37 (91%)	47 (253%)
November	38 (1,033%)	22 (1,800%)	12 (NA)	6 (NA)	4 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	25 (333%)	16 (433%)	7 (600%)	4 (NA)	2 (NA)
April	12 (18%)	19 (33%)	33 (108%)	37 (214%)	20 (178%)
<b>NAA vs. A1A_LLT</b>					
October	0 (0%)	-1 (-1%)	-5 (-5%)	-11 (-13%)	-12 (-16%)
November	-20 (-32%)	-17 (-42%)	-20 (-62%)	-12 (-67%)	-2 (-40%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-12 (-28%)	-9 (-30%)	-2 (-22%)	-4 (-50%)	-1 (-33%)
April	-7 (-8%)	-5 (-6%)	-9 (-12%)	-5 (-8%)	-7 (-19%)

NA = could not be calculated because the denominator was 0.

4

5 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during  
 6 October through April (Table 11-1A-42). Total degree-months would be similar between NAA and  
 7 Alternative 1A for all months except October, November, and March, in which degree-months would  
 8 be 5% to 33% lower under Alternative 1A.

1  
2  
3

**Table 11-1A-42. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
October	Wet	75 (103%)	-27 (-15%)
	Above Normal	27 (61%)	-9 (-11%)
	Below Normal	41 (75%)	-8 (-8%)
	Dry	56 (106%)	-15 (-12%)
	Critical	42 (102%)	-2 (-2%)
	All	241 (91%)	-61 (-11%)
November	Wet	19 (NA)	-18 (-49%)
	Above Normal	13 (650%)	-6 (-29%)
	Below Normal	14 (1,400%)	-7 (-32%)
	Dry	19 (NA)	-12 (-39%)
	Critical	18 (1,800%)	0 (0%)
	All	83 (2,075%)	-43 (-33%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-2 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	-2 (-100%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-1 (-100%)
	Dry	1 (NA)	1 (NA)
	Critical	2 (NA)	0 (0%)
	All	2 (NA)	-1 (-33%)
March	Wet	5 (NA)	0 (0%)
	Above Normal	-1 (-100%)	-3 (-100%)
	Below Normal	17 (1,700%)	-4 (-18%)
	Dry	24 (600%)	1 (4%)
	Critical	17 (425%)	0 (0%)
	All	63 (630%)	-5 (-6%)
April	Wet	38 (271%)	0 (0%)
	Above Normal	26 (113%)	-1 (-2%)
	Below Normal	24 (60%)	-1 (-2%)
	Dry	37 (76%)	-4 (-4%)
	Critical	31 (107%)	0 (0%)
	All	156 (101%)	-6 (-2%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
2 Feather River under A1A\_LLT would be similar to or up to 68% lower than mortality under NAA in  
3 all water years (Table 11-1A-43).

4 **Table 11-1A-43. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**  
5 **Salmon Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	5 (379%)	-14 (-68%)
Above Normal	6 (553%)	-6 (-45%)
Below Normal	12 (654%)	-2 (-10%)
Dry	13 (599%)	-6 (-27%)
Critical	21 (428%)	-3 (-9%)
All	11 (499%)	-7 (-36%)

6

7 ***American River***

8 *Fall-Run*

9 Flows in the American River at the confluence with the Sacramento River were examined during the  
10 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
11 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT during November through January  
12 would generally be similar to flows under NAA, except for above normal water years during  
13 November (18% lower) and below normal water years during December (7% higher). Flows under  
14 A1A\_LLT during October would be 13% to 42% greater than flows under NAA.

15 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
16 during the October through January fall-run Chinook salmon spawning and egg incubation period  
17 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
18 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
19 temperature between NAA and Alternative 1A in any month or water year type throughout the  
20 period.

21 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
22 Avenue Bridge was evaluated during November through April (Table 11-1A-44). The percent of  
23 months exceeding the threshold under Alternative 1A would similar to or up to 12% lower (absolute  
24 scale) than the percent under NAA.

1 **Table 11-1A-44. Differences between Baseline and Alternative 1A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**  
 3 **River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LL1</b>					
November	43 (95%)	49 (182%)	49 (364%)	40 (1,600%)	32 (2,600%)
December	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	25 (200%)	14 (183%)	12 (500%)	10 (800%)	5 (NA)
April	25 (35%)	25 (40%)	27 (59%)	30 (92%)	22 (82%)
<b>NAA vs. A1A_LL1</b>					
November	-4 (-4%)	-9 (-10%)	-11 (-15%)	-15 (-26%)	-7 (-18%)
December	1 (100%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
March	-12 (-25%)	-11 (-35%)	-1 (-8%)	-1 (-10%)	0 (0%)
April	-1 (-1%)	-6 (-7%)	-7 (-9%)	-10 (-14%)	-7 (-13%)

NA = could not be calculated because the denominator was 0.

4  
 5 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
 6 Avenue Bridge during November through April (Table 11-1A-45). Total degree-months would be  
 7 similar between NAA and Alternative 1A for all months.

1 **Table 11-1A-45. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**  
 3 **American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
November	Wet	79 (316%)	-3 (-3%)
	Above Normal	31 (282%)	-5 (-11%)
	Below Normal	45 (563%)	2 (4%)
	Dry	46 (354%)	-5 (-8%)
	Critical	35 (219%)	-3 (-6%)
	All	236 (323%)	-14 (-4%)
December	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	4 (NA)	2 (100%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	3 (NA)	-1 (-25%)
	All	3 (NA)	-1 (-25%)
March	Wet	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	10 (333%)	-1 (-7%)
	Dry	24 (600%)	-1 (-3%)
	Critical	20 (200%)	0 (0%)
	All	73 (384%)	-4 (-4%)
April	Wet	58 (207%)	0 (0%)
	Above Normal	33 (150%)	-1 (-2%)
	Below Normal	38 (106%)	-3 (-4%)
	Dry	41 (54%)	-4 (-3%)
	Critical	33 (56%)	-2 (-2%)
	All	203 (92%)	-10 (-2%)

NA = could not be calculated because the denominator was 0.

4

5 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
 6 comparing the magnitude of flow reduction each month over the incubation period compared to the  
 7 flow in October when spawning is assumed to occur. The greatest monthly reduction in American

1 River flows during November through January under A1A\_LLT be 16% to 53% greater in magnitude  
2 than under NAA (Table 11-1A-46).

3 **Table 11-1A-46. Difference and Percent Difference in Greatest Monthly Reduction (Percent**  
4 **Change) in Instream Flow in the American River at Nimbus Dam during the October through**  
5 **January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-32 (-150%)	-8 (-17%)
Above Normal	-16 (-54%)	-6 (-16%)
Below Normal	-44 (-227%)	-16 (-35%)
Dry	-17 (-37%)	-20 (-44%)
Critical	-9 (-18%)	-21 (-53%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

6

7 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
8 American River under A1A\_LLT would be similar to mortality under NAA in all water years (Table  
9 11-1A-47).

10 **Table 11-1A-47. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**  
11 **Salmon Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	25 (165%)	1 (3%)
Above Normal	21 (204%)	-1 (-3%)
Below Normal	20 (165%)	-2 (-5%)
Dry	17 (102%)	0.3 (1%)
Critical	9 (44%)	-1 (-2%)
All	20 (129%)	-0.1 (-0.2%)

12

13 ***Stanislaus River***

14 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
15 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
16 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to  
17 flows under NAA throughout the period.

18 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative  
19 1A throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*  
20 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
3 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
4 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to flows under NAA throughout  
5 the period.

6 Water temperature modeling was not conducted in the San Joaquin River.

7 **Mokelumne River**

8 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
9 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
10 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to flows under NAA throughout  
11 the period.

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **NEPA Effects:** Collectively, it is concluded that the effect is not adverse because habitat conditions  
14 are not substantially reduced. There would be no reductions in flows or increases in temperatures  
15 under Alternative 1A that would translate into adverse biological effects on fall-run Chinook salmon  
16 in any river examined and there would be beneficial temperature-related effects of Alternative 1A in  
17 the Feather River.

18 **CEQA Conclusion:**

19 In general, Alternative 1A would not affect the quantity and quality of spawning and egg incubation  
20 habitat for fall-/late fall-run Chinook salmon relative to the Existing Conditions.

21 **Sacramento River**

22 *Fall-Run*

23 Flows in the Sacramento River upstream of Red Bluff were examined during the October through  
24 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*  
25 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be greater than or  
26 similar to Existing Conditions during October, December, and January. During November however,  
27 flows under A1A\_LLT would be up to 21% lower than under Existing Conditions depending on  
28 water year type.

29 Shasta Reservoir storage volume at the end of September would be 9% to 33% lower under  
30 A1A\_LLT relative to Existing Conditions (Table 11-1A-21).

31 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
32 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
33 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
34 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
35 between Existing Conditions and Alternative 1A during the period, except during October, in which  
36 temperatures would be 5% higher under Alternative 1A.

37 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
38 increments was determined for each month during October through April and year of the 82-year  
39 modeling period (Table 11-1A-11). The combination of number of days and degrees above the 56°F

1 threshold were further assigned a “level of concern”, as defined in Table 11-1A-12. Differences  
2 between baselines and Alternative 1A in the highest level of concern across all months and all 82  
3 modeled years are presented in Table 11-1A-22. There would be 250% and 200% increases in the  
4 number of years with “red” and “orange” levels of concern under Alternative 1A relative to Existing  
5 Conditions.

6 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
7 October through April. Total degree-days under Alternative 1A would be 181% to 4154% higher  
8 than those under Existing Conditions during October, November, March, and April, and similar  
9 during December through February (Table 11-1A-23).

10 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
11 Sacramento River under A1A\_LLT would be 30% to 144% greater than mortality under Existing  
12 Conditions, which is a 9% to 18% increase on an absolute scale (Table 11-1A-36).

13 SacEFT predicts that there would be a 10% decrease in the percentage of years with good spawning  
14 availability, measured as weighted usable area, under A1A\_LLT relative to Existing Conditions  
15 (Table 11-1A-37). SacEFT predicts that there would be a 13% increase in the percentage of years  
16 with good (lower) redd scour risk under A1A\_LLT relative to Existing Conditions. SacEFT predicts  
17 that there would be a 28% decrease in the percentage of years with good (lower) egg incubation  
18 conditions under A1A\_LLT relative to Existing Conditions. SacEFT predicts that there would be a 7%  
19 increase in the percentage of years with good (lower) redd dewatering risk under A1A\_LLT relative  
20 to Existing Conditions.

#### 21 *Late Fall–Run*

22 Flows in the Sacramento River upstream of Red Bluff were examined during the February through  
23 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*  
24 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be greater than or  
25 similar to flows under Existing Conditions, except in wet years during May (14% lower).

26 Shasta Reservoir storage volume at the end of September would be 9% to 33% lower under  
27 A1A\_LLT relative to Existing Conditions (Table 11-1A-21).

28 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
29 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix  
30 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
31 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
32 between Existing Conditions and Alternative 1A in any month or water year type throughout the  
33 period.

34 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
35 increments was determined for each month during October through April and year of the 82-year  
36 modeling period (Table 11-1A-11). The combination of number of days and degrees above the 56°F  
37 threshold were further assigned a “level of concern”, as defined in Table 11-1A-12. Differences  
38 between baselines and Alternative 1A in the highest level of concern across all months and all 82  
39 modeled years are presented in Table 11-1A-22. There would be 250% and 200% increases in the  
40 number of years with “red” and “orange” levels of concern under Alternative 1A relative to Existing  
41 Conditions.

1 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
2 October through April. Total degree-days under Alternative 1A would be 181% to 4154% higher  
3 than those under Existing Conditions during October, November, March, and April, and similar  
4 during December through February (Table 11-1A-23).

5 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the  
6 Sacramento River under A1A\_LLT would be 124% to 329% greater than mortality under Existing  
7 Conditions (Table 11-1A-38). However, absolute differences in the percent of the late-fall population  
8 subject to mortality would be minimal in all but below normal years, in which there is a 5% increase.

9 SacEFT predicts that there would be a 17% decrease in the percentage of years with good spawning  
10 availability, measured as weighted usable area, under A1A\_LLT relative to Existing Conditions  
11 (Table 11-1A-39). SacEFT predicts that there would be a 6% decrease in the percentage of years  
12 with good (lower) redd scour risk under A1A\_LLT relative to Existing Conditions. SacEFT predicts  
13 that there would be no difference in the percentage of years with good (lower) egg incubation  
14 conditions under A1A\_LLT relative to Existing Conditions. SacEFT predicts that there would be an  
15 11% decrease in the percentage of years with good (lower) redd dewatering risk under A1A\_LLT  
16 relative to Existing Conditions.

### 17 **Clear Creek**

18 No water temperature modeling was conducted in Clear Creek.

#### 19 *Fall-Run*

20 Flows in Clear Creek below Whiskeytown Reservoir under A1A\_LLT during the September through  
21 February fall-run spawning and egg incubation period would be similar to or greater than flows  
22 under Existing Conditions.

23 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of  
24 flow reduction each month over the incubation period compared to the flow in September when  
25 spawning occurred. The greatest monthly reduction in Clear Creek flows during September through  
26 February under A1A\_LLT would be similar to or lower magnitude than those under Existing  
27 Conditions in wet and below normal water years, but the reduction would be 27%, 67%, and 33%  
28 greater (absolute, not relative, differences) under A1A\_LLT in above normal, dry, and critical water  
29 years, respectively (Table 11-1A-40).

### 30 **Feather River**

#### 31 *Fall-Run*

32 Flows in the low-flow channel during October through January under A1A\_LLT would be identical to  
33 those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
34 Flows in the high-flow channel under A1A\_LLT would generally be similar to or greater by up to  
35 51% than flows under Existing Conditions.

36 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
37 comparing the magnitude of flow reduction each month over the incubation period compared to the  
38 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were  
39 identical between A1A\_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized*

1 *in the Fish Analysis*). Therefore, there would be no effect of Alternative 1A on redd dewatering in the  
2 Feather River low-flow channel.

3 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
4 Feather River under A1A\_LL1T would be 379% to 599% greater than mortality under Existing  
5 Conditions (Table 11-1A-43).

6 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
7 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October  
8 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,  
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
10 *Fish Analysis*). Mean monthly water temperatures would be under Alternative 1A relative to Existing  
11 Conditions by 7% to 10% higher in the low-flow channel and 6% to 8% higher in the high-flow  
12 channel depending on month.

13 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley  
14 was evaluated during October through April (Table 11-1A-41). The percent of months exceeding the  
15 threshold under Alternative 1A would similar to or up to 47% higher (absolute scale) than the  
16 percent under Existing Conditions during all months except December through February, during  
17 which there would be no difference in the percent of months exceeding the threshold.

18 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during  
19 October through April (Table 11-1A-42). Total degree-months under Alternative 1A would be 91%  
20 to 2075% higher than total degree-months under Existing Conditions, except during December  
21 through February, in which there would be no difference between Existing Conditions and  
22 Alternative 1A in total degree-months exceeding the 56°F threshold.

### 23 ***American River***

#### 24 *Fall-Run*

25 Flows in the American River at the confluence with the Sacramento River were examined during the  
26 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LL1T would be greater than flows under  
28 Existing Conditions during October, but generally lower by up to 38% than flows under Existing  
29 Conditions during November through January.

30 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
31 during the October through January fall-run Chinook salmon spawning and egg incubation period  
32 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
33 *utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 1A would be 5% to 12%  
34 greater than those under Existing Conditions depending on month.

35 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
36 Avenue Bridge was evaluated during November through April (Table 11-1A-44). The percent of  
37 months exceeding the threshold under Alternative 1A would be up to 49% greater (absolute scale)  
38 than the percent under Existing Conditions during November, March, and April and similar to the  
39 percent under Existing Conditions during December through February.

40 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
41 Avenue Bridge during November through April (Table 11-1A-45). Total degree-months under

1 Alternative 1A would be 92% to 323% greater than total degree-months under Existing Conditions  
2 during November, March and April and similar to total degree months under Existing Conditions  
3 during December through February.

4 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
5 comparing the magnitude of flow reduction each month over the incubation period compared to the  
6 flow in October when spawning is assumed to occur. The greatest monthly reduction in American  
7 River flows during November through January under A1A\_LLT would be 18% to 227% greater  
8 magnitude than those under Existing Conditions, depending on water year type (Table 11-1A-46).  
9 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
10 American River under A1A\_LLT would be 44% to 204% greater than mortality under Existing  
11 Conditions (Table 11-1A-47).

### 12 **Stanislaus River**

13 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
14 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
15 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be up to 18%  
16 lower than those under Existing Conditions throughout the period.

17 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were  
18 examined during the October through January fall-run spawning and egg incubation period  
19 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
20 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would not be  
21 different from those under Existing Conditions during October, but 6% higher during November  
22 through January.

### 23 **San Joaquin River**

24 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
25 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
26 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be up to 8% lower than Existing  
27 Conditions in most water years during October, similar to Existing Conditions in November and  
28 December (each month with one water year greater than 5% lower), and up to 6% higher than  
29 Existing Conditions during January.

30 Water temperature modeling was not conducted in the San Joaquin River.

### 31 **Mokelumne River**

32 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
33 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
34 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be up to 14% lower than flows under  
35 Existing Conditions during October and November, up to 15% greater than flows under Existing  
36 Conditions during December, and similar to flows under Existing Conditions during January.

37 Water temperature modeling was not conducted in the Mokelumne River.

### 38 **Summary of CEQA Conclusion**

39 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between  
40 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the

1 alternative could substantially reduce the amount of suitable spawning and egg incubation habitat,  
2 contrary to the NEPA conclusion set forth above. There would be flow reductions or temperature  
3 increases in the Sacramento, Feather, and American Rivers that would have biologically meaningful  
4 effects on fall-/late fall-run Chinook salmon spawning and egg incubation habitat.

5 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
6 change, future water demands, and implementation of the alternative. The analysis described above  
7 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
8 the alternative from those of sea level rise, climate change and future water demands using the  
9 model simulation results presented in this chapter. However, the increment of change attributable  
10 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
11 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
12 implementation period, which does include future sea level rise, climate change, and water  
13 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
14 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
15 effect of the alternative from those of sea level rise, climate change, and water demands.

16 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
17 term implementation period and Alternative 1A indicates that flows in the locations and during the  
18 months analyzed above would generally be similar between Existing Conditions during the LLT and  
19 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
20 found above would generally be due to climate change, sea level rise, and future demand, and not  
21 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
22 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
23 result in a significant impact on spawning and egg incubation habitat for fall-run Chinook salmon.  
24 This impact is found to be less than significant and no mitigation is required.

### 25 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 26 **(Fall-/Late Fall-Run ESU)**

27 In general, Alternative 1A would not affect the quantity and quality of larval and juvenile rearing  
28 habitat for fall- and late fall-run Chinook salmon relative to NAA.

#### 29 ***Sacramento River***

##### 30 *Fall-Run*

31 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
32 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
33 *Analysis*). Flows under A1A\_LL1T would be greater than or similar to flows under NAA throughout  
34 the period, except for January in critical water years, when flows are estimated to be about 11%  
35 lower.

36 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and  
37 juvenile rearing period. Storage under A1A\_LL1T would be greater than storage under NAA in wet  
38 (8% higher) and above normal (5% higher) water years, 9% lower than storage under NAA in below  
39 normal water years, and similar to storage under NAA in dry and critical water years (Table 11-1A-  
40 21).

41 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
42 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*

1 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis).*  
2 There would be no differences (<5%) in mean monthly water temperature between NAA and  
3 Alternative 1A in any month or water year type throughout the period.

4 SacEFT predicts that there would be a 15% decrease in the percentage of years with good juvenile  
5 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A1A\_LLT  
6 relative to NAA (Table 11-1A-37). SacEFT predicts that there would be a 40% increase in the  
7 percentage of years with “good” (lower) juvenile stranding risk under A1A\_LLT relative to NAA.

8 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A1A\_LLT would be  
9 5% lower than mortality under NAA.

#### 10 *Late Fall-Run*

11 Sacramento River flows upstream of Red Bluff were examined for the March through July late fall-  
12 run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*  
13 *Fish Analysis*). Flows throughout the period A1A\_LLT were generally similar to or greater than those  
14 under NAA.

15 Shasta Reservoir storage at the end of September and May would affect flows during the late fall-  
16 run larval and juvenile rearing period. Storage under A1A\_LLT would be greater than storage under  
17 NAA in wet (8% higher) and above normal (5% higher) water years, 9% lower than storage under  
18 NAA in below water years, and similar to storage under NAA in dry and critical water years (Table  
19 11-1A-21). May Shasta storage volume under A1A\_LLT would be similar to or up to 8% lower than  
20 storage under NAA for all water year types (Table 11-1A-10).

21 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
22 March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
23 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
24 There would be no differences (<5%) in mean monthly water temperature between NAA and  
25 Alternative 1A in any month or water year type throughout the period.

26 SacEFT predicts that there would be a 41% decrease in the percentage of years with good juvenile  
27 rearing availability for late fall-run Chinook salmon, measured as weighted usable area, under  
28 A1A\_LLT relative to NAA (Table 11-1A-39). SacEFT predicts that there would be no difference in the  
29 percentage of years with “good” (lower) juvenile stranding risk under A1A\_LLT relative to NAA.

30 SALMOD predicts that late fall-run smolt equivalent habitat-related mortality under A1A\_LLT would  
31 be similar to mortality under NAA.

#### 32 **Clear Creek**

33 No water temperature modeling was conducted in Clear Creek.

#### 34 *Fall-Run*

35 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
36 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
37 *Analysis*). Flows under A1A\_LLT would be similar to flows under NAA throughout the period.

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
4 channel) during December through June were reviewed to determine flow-related effects on larval  
5 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Relatively constant flows in the low flow channel throughout this period under A1A\_LLT  
7 would not differ from those under NAA. In the high flow channel, flows under A1A\_LLT would be up  
8 to 110% greater than flows under NAA throughout the period, except for January during critical  
9 water years, during which flows would be up to 15% lower.

10 May Oroville storage under A1A\_LLT would be similar to storage under NAA, except for dry years  
11 (5% higher) (Table 11-1A-30).

12 Oroville storage volume at the end of September under A1A\_LLT would be 18% to 31% greater than  
13 storage under NAA depending on water year type (Table 11-1A-27).

14 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
15 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
16 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
17 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences  
18 (<5%) in mean monthly water temperature between NAA and Alternative 1A in any month or water  
19 year type throughout the period at either location.

20 **American River**

21 *Fall-Run*

22 Flows in the American River at the confluence with the Sacramento River were examined for the  
23 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
24 *Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be similar to or greater  
25 than flows under NAA except in dry and critical years during March (9% lower in both water year  
26 types).

27 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
28 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
29 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
30 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
31 NAA and Alternative 1A in any month or water year type throughout the period.

32 **Stanislaus River**

33 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 1A are not  
34 different from those under NAA, for the January through May fall-run Chinook salmon juvenile  
35 rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA  
37 and Alternative 1A throughout the January through May fall-run rearing period (Appendix 11D,  
38 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
39 *Fish Analysis*).

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis for Alternative 1A are not different from those under NAA,  
3 for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*).

5 Water temperature modeling was not conducted in the San Joaquin River.

6 **Mokelumne River**

7 Flows in the Mokelumne River at the Delta for Alternative 1A are not different from those under  
8 NAA, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM*  
9 *II Model Results utilized in the Fish Analysis*).

10 Water temperature modeling was not conducted in the Mokelumne River.

11 **NEPA Effects:** Taken together, these results indicate that the effect is not adverse because it does not  
12 have the potential to substantially reduce the amount of suitable habitat of fish. Fall-run Chinook  
13 salmon would experience beneficial effects of Alternative 1A in the Sacramento River and would not  
14 be affected in any upstream waterway. SacEFT predicts that there would be a 41% decrease in the  
15 percentage of years with good juvenile rearing availability for late fall-run, although modeled flow  
16 outputs predict that flows, which drive rearing habitat availability, would increase during the  
17 rearing period. In addition, the number of years with good juvenile stranding risk for late fall-run  
18 Chinook salmon as predicted by SacEFT would not differ between Alternative 1A and the NEPA  
19 baseline, nor would smolt equivalent habitat-related mortality as predicted by SALMOD. There are  
20 no effects of Alternative 1A on fall-run or late-fall-run in other waterways that would rise to the  
21 level of adverse.

22 **CEQA Conclusion:** In general, Alternative 1A would not affect the quantity and quality of larval and  
23 juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to the Existing Conditions.

24 **Sacramento River**

25 *Fall-Run*

26 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
27 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
28 *Analysis*). Flows under A1A\_LL1T would generally be greater than or similar to flows under Existing  
29 Conditions, except in wet years during May (14% lower).

30 End of September Shasta Reservoir storage under A1A\_LL1T would be greater than storage under  
31 NAA in wet (8% higher) and above normal (5% higher) water years, 9% lower than storage under  
32 NAA in below water years, and similar to storage under NAA in dry and critical water years (Table  
33 11-1A-21).

34 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
35 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
36 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
37 There would be no differences (<5%) in mean monthly water temperature between Existing  
38 Conditions and Alternative 1A in any month or water year type throughout the period. SacEFT  
39 predicts that there would be a 3% increase in the percentage of years with good juvenile rearing  
40 availability for fall-run Chinook salmon, measured as weighted usable area, under A1A\_LL1T relative

1 to Existing Conditions (Table 11-1A-37). SacEFT predicts that there would be a 10% reduction in the  
2 percentage of years with “good” (lower) juvenile stranding risk under A1A\_LLT relative to Existing  
3 Conditions.

4 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A1A\_LLT would be  
5 12% lower than mortality under Existing Conditions.

#### 6 *Late Fall–Run*

7 Sacramento River flows upstream of Red Bluff were examined for the March through July late fall–  
8 run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*  
9 *Fish Analysis*). Flows during the period would generally be similar to or greater than those under  
10 Existing Conditions, except in wet water years during May (14% lower).

11 Sacramento River flows upstream of Red Bluff were examined for the March through July late fall–  
12 run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*  
13 *Fish Analysis*). Flows during July, under A1A\_LLT were generally lower by up to 10% than those  
14 under Existing Conditions for most water year types. Flows during other months were generally  
15 similar to or greater than those under Existing Conditions, except in wet water years during May  
16 (14% lower).

17 End of September Shasta Reservoir storage would be 9% to 33% lower under A1A\_LLT relative to  
18 Existing Conditions depending on water year type (Table 11-1A-21).

19 End of May Shasta storage under A1A\_LLT would be similar to Existing Conditions in wet and above  
20 normal water years, but lower by 13% to 25% in below normal, dry, and critical water years (Table  
21 11-1A-10).

22 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
23 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
24 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
25 There would be no differences (<5%) in mean monthly water temperature between Existing  
26 Conditions and Alternative 1A in any month or water year type throughout the period.

27 SacEFT predicts that there would be an 18% reduction in the percentage of years with good juvenile  
28 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under  
29 A1A\_LLT relative to Existing Conditions (Table 11-1A-39). SacEFT predicts that there would be a  
30 36% reduction in the percentage of years with “good” (lower) juvenile stranding risk under  
31 A1A\_LLT relative to Existing Conditions.

32 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A1A\_LLT would  
33 be 7% higher than mortality under Existing Conditions.

#### 34 *Clear Creek*

35 No temperature modeling was conducted in Clear Creek.

#### 36 *Fall-Run*

37 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
38 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

1 *Analysis*). Flows under A1A\_LLT would be similar to or greater (by up to 54%) than flows under  
2 Existing Conditions for the entire period.

### 3 **Feather River**

#### 4 *Fall-Run*

5 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
6 channel) during December through June were reviewed to determine flow-related effects on larval  
7 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*). Relatively constant flows in the low flow channel throughout the period under A1A\_LLT  
9 would not differ from those under Existing Conditions. In the high flow channel, flows under  
10 A1A\_LLT would be mostly greater than flows under Existing Conditions by up to 204% with few  
11 exceptions.

12 May Oroville storage volume under A1A\_LLT would be lower than Existing Conditions by 7% to 15%  
13 depending on water year type, except in wet years, in which storage would be similar to Existing  
14 Conditions (Table 11-1A-30).

15 Oroville Reservoir storage volume at the end of September would be similar under A1A\_LLT relative  
16 to Existing Conditions during dry and critical water years, but moderately lower (up to 21% lower)  
17 for other water year types (Table 11-1A-27).

18 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
19 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
20 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
21 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean  
22 monthly water temperatures under Alternative 1A would be 5% to 10% higher than those under  
23 Existing Conditions during December through March, but not different from those under Existing  
24 Conditions during April through June. In the high-flow channel, mean monthly water temperatures  
25 under Alternative 1A would be 5% to 8% higher than those under Existing Conditions during  
26 December through February, but not different from those under Existing Conditions during March  
27 through June.

### 28 **American River**

#### 29 *Fall-Run*

30 Flows in the American River at the confluence with the Sacramento River were examined for the  
31 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
32 *Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be similar to or up to  
33 29% greater than flows under Existing Conditions for most water year types, except during January  
34 and May, when flows would be up to 27% lower depending on water year type. Mean monthly water  
35 temperatures in the American River at the Watt Avenue Bridge were examined during the January  
36 through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River*  
37 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
38 monthly water temperatures under Alternative 1A would be 5% to 7% higher than those under  
39 Existing Conditions during January through March, but not different during April and May.

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 1A would  
3 be up to 36% lower than Existing Conditions in January through May fall-run larval and juvenile  
4 rearing period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
5 *Analysis*).

6 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
7 River were examined during the January through May fall-run Chinook salmon juvenile rearing  
8 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
9 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
10 be 6% higher than those under Existing Conditions in all months during the period.

11 **San Joaquin River**

12 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run  
13 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*  
14 *the Fish Analysis*). Flows under A1A\_LLT would generally be similar to flows under Existing  
15 Conditions during January and February and lower by up to 15% during March through May.

16 Water temperature modeling was not conducted in the San Joaquin River.

17 **Mokelumne River**

18 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook  
19 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
20 *Analysis*). Flows under A1A\_LLT would be similar to flows under Existing Conditions during January  
21 through March and lower by up to 18% than flows under Existing Conditions during April and May.

22 Water temperature modeling was not conducted in the Mokelumne River.

23 **Summary of CEQA Conclusion**

24 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between  
25 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
26 alternative could substantially reduce the fall-/late fall-run Chinook salmon rearing habitat,  
27 contrary to the NEPA conclusion set forth above. SacEFT and SALMOD predict negative effects of  
28 Alternative 1A on fall-run and late fall-run Chinook salmon rearing conditions in the Sacramento  
29 River. There would be small reductions in mean monthly water temperatures under Alternative 1A  
30 in the Feather River. There would be consistent moderate flow reductions under Alternative 1A in  
31 the Stanislaus River and small reductions in the San Joaquin and Mokelumne Rivers. There would,  
32 however, be beneficial effects of Alternative 1A to fall-run Chinook salmon in the Feather River.

33 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
34 change, future water demands, and implementation of the alternative. The analysis described above  
35 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
36 the alternative from those of sea level rise, climate change and future water demands using the  
37 model simulation results presented in this chapter. However, the increment of change attributable  
38 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
39 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
40 implementation period, which does include future sea level rise, climate change, and water  
41 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
4 term implementation period and Alternative 1A indicates that flows in the locations and during the  
5 months analyzed above would generally be similar between Existing Conditions during the LLT and  
6 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
7 found above would generally be due to climate change, sea level rise, and future demand, and not  
8 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
9 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
10 result in a significant impact on rearing incubation habitat for fall-/late fall-run Chinook salmon.  
11 This impact is found to be less than significant and no mitigation is required.

## 12 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon** 13 **(Fall-/Late Fall-Run ESU)**

### 14 **Upstream of the Delta**

15 In general, Alternative 1A would reduce migration conditions for fall-/late fall-run Chinook salmon  
16 relative to NAA.

#### 17 ***Sacramento River***

##### 18 *Fall-Run*

19 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants under A1A\_LL  
20 T would be similar to or up to 14% greater than flows under NAA throughout the February through  
21 May juvenile fall-run Chinook salmon migration period in all water year types (Appendix 11C,  
22 *CALSIM II Model Results utilized in the Fish Analysis*).

23 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
24 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
25 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
26 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
27 NAA and Alternative 1A in any month or water year type throughout the period.

28 Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run  
29 Chinook salmon upstream migration period (September through October) (Appendix 11C, *CALSIM II*  
30 *Model Results utilized in the Fish Analysis*). During September, flows under A1A\_LL  
31 T would generally be lower by up to 44% than those under NAA. During October, flows under A1A\_LL  
32 T would be 12% to 33% higher than those under NAA.

33 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
34 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
35 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
36 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
37 between NAA and Alternative 1A in any month or water year type throughout the period.

1 **Late Fall-Run**

2 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run Chinook salmon  
3 migrants (January through March) under A1A\_LLT would generally be similar to flows under NAA  
4 with some small exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
6 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
8 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
9 NAA and Alternative 1A in any month or water year type throughout the period.

10 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon  
11 upstream migration period (December through February) under A1A\_LLT would be generally be  
12 similar to flows under NAA with some small exceptions (Appendix 11C, *CALSIM II Model Results*  
13 *utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
15 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,  
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
18 NAA and Alternative 1A in any month or water year type throughout the period.

19 **Clear Creek**

20 Water temperature modeling was not conducted in Clear Creek.

21 **Fall-Run**

22 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run  
23 migrants during February through May. Flows under A1A\_LLT would be similar to flows under NAA  
24 during all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
26 upstream migration period (September through October) under A1A\_LLT would be similar to those  
27 under NAA throughout the period, except for critical years during September (13% lower) and  
28 October (5% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 **Feather River**

30 **Fall-Run**

31 Flows in the Feather River at the confluence with the Sacramento River during the juvenile fall-run  
32 Chinook salmon emigration period (February through May) under A1A\_LLT would generally be up  
33 to 110% greater than flows under NAA with few exceptions (Appendix 11C, *CALSIM II Model Results*  
34 *utilized in the Fish Analysis*).

35 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
36 were examined during the February through May juvenile fall-run Chinook salmon migration period  
37 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
38 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
39 temperature between NAA and Alternative 1A in any month or water year type throughout the  
40 period.

1 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
2 September through October fall-run Chinook salmon adult migration period (Appendix 11C, *CALSIM*  
3 *II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be lower by up  
4 to 69% than flows under NAA during September, but greater by up to 55% than flows under NAA  
5 during October.

6 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
7 were examined during the September through October fall-run Chinook salmon adult upstream  
8 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
9 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
10 mean monthly water temperature between NAA and Alternative 1A in any month or water year type  
11 throughout the period.

## 12 **American River**

### 13 *Fall-Run*

14 Flows in the American River at the confluence with the Sacramento River were examined during the  
15 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM*  
16 *II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be greater than flows under  
17 NAA during May and generally similar to flows under NAA with some small exceptions).

18 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
19 River were examined during the February through May juvenile fall-run Chinook salmon migration  
20 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
21 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
22 temperature between NAA and Alternative 1A in any month or water year type throughout the  
23 period.

24 Flows in the American River at the confluence with the Sacramento River were examined during the  
25 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
26 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be lower by up to  
27 50% than those under NAA during September), but greater by up to 42% during October.

28 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
29 River were examined during the September and October adult fall-run Chinook salmon upstream  
30 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
31 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
32 mean monthly water temperature between NAA and Alternative 1A in any month or water year type  
33 throughout the period.

## 34 **Stanislaus River**

### 35 *Fall-Run*

36 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
37 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM*  
38 *II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to those under  
39 NAA in all months and water year types throughout the period.

1 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
2 River were examined during the February through May juvenile fall-run Chinook salmon migration  
3 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
4 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
5 temperature between NAA and Alternative 1A in any month or water year type throughout the  
6 period.

7 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
8 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
9 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to those  
10 under NAA in all months and water year types throughout the period.

11 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
12 River were examined during the September and October adult fall-run Chinook salmon upstream  
13 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
14 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
15 mean monthly water temperature between NAA and Alternative 1A in any month or water year type  
16 throughout the period.

### 17 ***San Joaquin River***

#### 18 *Fall-Run*

19 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
20 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
21 *Analysis*). Flows under A1A\_LLT would be similar to those under NAA in all months and water year  
22 types throughout the period.

23 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
24 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
25 *in the Fish Analysis*). Flows under A1A\_LLT would be similar to those under NAA in all months and  
26 water year types throughout the period.

27 Water temperature modeling was not conducted in the San Joaquin River.

### 28 ***Mokelumne River***

#### 29 *Fall-Run*

30 Flows in the Mokelumne River at the Delta were examined during the February through May  
31 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
32 *the Fish Analysis*). Flows under A1A\_LLT would be similar to those under NAA in all months and  
33 water year types throughout the period.

34 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
35 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
36 *in the Fish Analysis*). Flows under A1A\_LLT would be similar to those under NAA in all months and  
37 water year types throughout the period.

38 Water temperature modeling was not conducted in the Mokelumne River.

1 **Through-Delta**  
2 **Sacramento River**  
3 *Fall-Run*  
4 *Juveniles*

5 Plan Area flows have considerable importance for downstream migrating juvenile salmonids and  
6 would be affected by the north Delta diversions, as discussed above for winter-run Chinook above  
7 (Impact AQUA-42 for Alternative 1A). During the juvenile fall-run Chinook salmon migration period  
8 (February through May), mean monthly flows in the Sacramento River below the NDD would be  
9 reduced compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
10 Mean monthly flows during this period were lower (up to 23% lower) under Alternative 1A  
11 compared to baseline conditions (NAA) when averaged across all water years, with flows reduced  
12 up to 32% in April of above normal years. As discussed in Impact AQUA-42, *CM1 Water Facilities and*  
13 *Operation* includes bypass flow criteria that will be managed in real time to minimize adverse effects  
14 of diversions at the north Delta intakes on downstream-migrating salmonids.

15 Through-Delta survival of migrating fall-run Chinook salmon smolts from the Sacramento River, as  
16 estimated by DPM under Alternative 1A, averaged 24% across all years, 22% in drier years, and  
17 29% in wetter years (Table 11-1A-48). Compared to baseline conditions (NAA), average survival  
18 would be 2% lower (7% relative decrease) in wetter years, and similar in drier years and across all  
19 years.

20 **Table 11-1A-48. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**  
21 **Alternative 1A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A1A_LL1	EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
<b>Sacramento River</b>					
Wetter Years	34.5	31.1	28.8	-5.7 (-16%)	-2.3 (-7%)
Drier Years	20.6	20.8	21.7	1.1 (5%)	0.9 (4%)
All Years	25.8	24.7	24.4	-1.4 (-6%)	-0.3 (-1%)
<b>Mokelumne River</b>					
Wetter Years	17.2	15.7	15.4	-1.7 (-10%)	-0.3 (-2%)
Drier Years	15.6	15.9	15.6	-0.1 (<1%)	-0.4 (-2%)
All Years	16.2	15.9	15.5	-0.7 (-4%)	-0.4 (-2%)
<b>San Joaquin River</b>					
Wetter Years	19.3	20.3	18.0	-1.4 (-7%)	-2.3 (-11%)
Drier Years	10.0	9.5	10.6	0.6 (6%)	1.1 (11%)
All Years	13.5	13.6	13.4	-0.1 (-1%)	-0.2 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.  
Wetter = Wet and above normal water years (6 years).  
Drier = Below normal, dry and critical water years (10 years).

22

1 Potential predation at the north Delta intakes could occur if predatory fish aggregated along the  
2 screens as has been observed at other long screens in the Central Valley (Vogel 2008). Baseline  
3 levels of predation are uncertain, however. Analysis by a bioenergetics model (Appendix 5.F,  
4 *Biological Stressors on Covered Fish*, Section 5.F.3.2.1) indicates a predation loss of annual  
5 production from the Sacramento River basin of 1.8% for fall-run Chinook salmon and 4.9% for late  
6 fall-run Chinook salmon (Table 11-1A-17). A more conservative estimate of predation (5% loss per  
7 intake) would yield a cumulative loss of about 20% of the annual production of fall-run and late fall-  
8 run Chinook salmon that reach the north Delta. The five intake structures would also permanently  
9 displace approximately 22 acres of in-water habitat along the migration route. However, there are  
10 appreciable uncertainties in these analyses, including unknown baseline levels of predation,  
11 uncertainty in the bioenergetics model parameters, and the comparability of the GCID intakes for  
12 estimating loss rates.

### 13 *Adults*

14 Adult salmonids migrating through the Delta use flow and olfactory cues for navigation to their natal  
15 streams (Marston et al. 2012), as discussed above for winter-run Chinook (Impact AQUA-42 for  
16 Alternative 1A). Sacramento River flows downstream of the proposed north Delta intakes generally  
17 will be lower under Alternative 1A operations relative to NAA, with differences between water-year  
18 types because of differences in the relative proportion of water being exported from the north Delta  
19 and south Delta facilities (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 During the adult fall-run Chinook salmon upstream migration from September to December, the  
21 proportion of Sacramento River water in the Delta would decrease 5% to 12% under Alternative 1A  
22 compared to NAA (Table 11-1A-49). Adult salmonid attraction due to olfactory cues could be  
23 adversely affected by dilution greater than 20%, but has not been discernibly affected by dilution of  
24 10% or less (Fretwell 1989).

1 **Table 11-1A-49. Percentage (%) of Water at Collinsville Originating in the Sacramento River during**  
 2 **the Adult Fall-Run and Late Fall-Run Chinook Salmon Migration Period for Alternative 1A**

Month	Scenario			Percentage Difference	
	EXISTING CONDITIONS	NAA	A1A_LLT	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>Fall-Run—Sacramento River</b>					
September	60	65	53	-7	-12
October	60	68	64	4	-4
November	60	66	61	1	-5
December	67	66	63	-4	-3
<b>Fall-Run—San Joaquin River</b>					
September	0.3	0.1	1.1	0.8	1
October	0.2	0.3	1.8	1.6	1.5
November	0.4	1.0	3.1	2.7	2.1
December	0.9	1.0	1.5	0.6	0.5
<b>Late Fall-Run—Sacramento River</b>					
December	67	66	63	-4	-3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
Shading indicates 10% or greater absolute difference.					

3

4 *Late Fall-Run*

5 *Juveniles*

6 During the juvenile late fall-run Chinook salmon emigration period (October-February), mean  
 7 monthly flows in the Sacramento River below the north Delta intakes under Alternative 1A averaged  
 8 across years would increase 15% in October and decrease (10%-31%) from November-February  
 9 compared to NAA. Flows would be up to 39% lower in November of above normal years. Through-  
 10 Delta survival rates under Alternative 1A would average 23% across all years, 27% in wetter years,  
 11 and 20% in drier years, which is similar to NAA (Table 11-1A-50).

12 Estimates of potential predation losses at the north Delta intakes range from 4.9% (bioenergetics  
 13 model, Table 11-1A-17) up to 20.3% (fixed 5% loss per intake) of annual production of late fall-run  
 14 salmon reaching the Delta. The five intake structures would displace approximately 22 acres of in-  
 15 water habitat. Uncertainties exist regarding baseline levels of predation, bioenergetics model  
 16 parameters, and comparability of the 5% loss based on GCID intakes.

1 **Table 11-1A-50. Through-Delta Survival (%) of Emigrating Juvenile Late Fall-Run Chinook Salmon**  
2 **under Alternative 1A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A1A_LLT	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wetter Years	28.8	27.3	27.3	-1.4 (-5%)	0 (0%)
Drier Years	18.8	20.2	20.4	1.7 (9%)	0.2 (1%)
All Years	22.5	22.9	23.0	0.5 (2%)	0.1 (1%)

Note: Delta Passage Model results for survival to Chipps Island.  
Wetter = Wet and above normal water years (6 years).  
Drier = Below normal, dry and critical water years (10 years).

3

4 *Adults*

5 During the adult late fall-run Chinook salmon upstream migration from September to December, the  
6 proportion of Sacramento River water in the Delta would be 63% to 71%, which would be 3% to 9%  
7 decrease compared to NAA (Table 11-1A-49). Adult salmonid attraction due to olfactory cues could  
8 be adversely affected by dilution greater than 20%, but has not been discernibly affected by dilution  
9 of 10% or less (Fretwell 1989).

10 ***Mokelumne River***

11 *Fall-Run*

12 *Juveniles*

13 Through-Delta survival of migrating fall-run Chinook salmon smolts from the Mokelumne River, as  
14 estimated by DPM under Alternative 1A, averaged 15.4-15.6% and was similar for wetter, drier, and  
15 all years (Table 11-1A-48). Compared to baseline conditions (NAA), average survival would be less  
16 than 0.5% lower (2% relative decrease).

17 ***San Joaquin River***

18 *Fall-Run*

19 *Juveniles*

20 Through-Delta survival of migrating fall-run Chinook salmon smolts from the San Joaquin River, as  
21 estimated by DPM under Alternative 1A, averaged 13% across all years, 18% in wetter years, and  
22 11% in drier years (Table 11-1A-48). Compared to baseline conditions (NAA), average survival  
23 would be 2% lower (11% relative decrease) in wetter years and 1% greater (11% relative increase)  
24 in drier years.

25 *Adults*

26 The percentage of water at Collinsville that originated from the San Joaquin River is small (no more  
27 than 1% under NAA) during the fall-run migration period (September to December) (Table 11-1A-  
28 49). Alternative 1A operations conditions would incrementally increase olfactory cues associated

1 with the San Joaquin River, which would benefit adult fall-run Chinook salmon migrating to the San  
2 Joaquin River.

### 3 **Predation Associated with Entrainment**

4 The effects would be the same as described for predation in Impact AQUA-57. While the estimated  
5 number of spring-run Chinook salmon juveniles predicted to be consumed by striped bass predators  
6 would be substantial (up to tens of thousands), the population level effect would be minimal (less  
7 than 1%) when compared to the annual production estimated for the Sacramento Valley (*BDCP*  
8 *Effects Analysis – Appendix 5F, Biological Stressors, Section F.5.3 Potential Effects: Benefits and Risks,*  
9 *hereby incorporated by reference*).

10 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 1A is adverse because it has  
11 the potential to substantially decrease fall- and late fall-run Chinook salmon migration habitat  
12 conditions upstream of the Delta. In addition, this alternative is adverse due to the cumulative  
13 effects associated with five north Delta intake facilities, including mortality related to near-field  
14 effects (e.g. impingement and predation) and far-field effects (reduced survival due to reduced flows  
15 downstream of the intakes) associated with the five NDD intakes.

16 Upstream of the Delta, flows in the Sacramento, Feather, and American rivers would be up to 69%  
17 lower during one of the two months of the fall-run Chinook salmon adult migration period. These  
18 reductions in flow may impact the ability of adult fall-run Chinook salmon to migrate upstream  
19 successfully. There would be no other effects of Alternative 1A on upstream flows or water  
20 temperatures during the juvenile or adult migration periods for fall- and late fall-run Chinook  
21 salmon.

22 Adult attraction flows in the Delta under Alternative 1A would be lower than those under NAA, but  
23 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

24 Near-field effects of Alternative 1A NDD on fall- and late fall-run Chinook salmon related to  
25 impingement and predation associated with five new intakes could result in substantial effects on  
26 juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty  
27 regarding the potential effects. Estimates within the effects analysis range from very low levels of  
28 effects (<2% mortality) to very significant effects (~ 20% mortality above current baseline levels).  
29 CM15 would be implemented with the intent of providing localized and temporary reductions in  
30 predation pressure at the NDD. Additionally, several pre-construction surveys to better understand  
31 how to minimize losses associated with the five new intake structures will be implemented as part  
32 of the final NDD screen design effort. Alternative 1A also includes an Adaptive Management Program  
33 and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments  
34 intended to provide adequate migration conditions for fall- and late fall-run Chinook salmon.  
35 However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento  
36 River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly  
37 uncertain.

38 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
39 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
40 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 1A  
41 predict improvements in smolt condition and survival associated with increased access to the Yolo  
42 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude

1 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
2 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

3 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
4 all of these elements of BDCP operations and conservation measures to predict smolt migration  
5 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
6 migration survival under Alternative 1A would be similar to survival rates estimated for NAA.  
7 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
8 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
9 future. These efforts are expected to improve our understanding of the relationships and  
10 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
11 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
12 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
13 1A on fall- and late fall-run Chinook salmon through-Delta survival remains uncertain.

14 Therefore, primarily as a result of reduced upstream migration habitat conditions for fall- and late  
15 fall-run Chinook salmon due to reduced flows along with unacceptable levels of uncertainty  
16 regarding the cumulative impacts of near-field and far-field effects associated with the presence and  
17 operation of the five intakes on fall- and late fall-run Chinook salmon, this effect is adverse.

18 While the implementation of the conservation and mitigation measures described below would  
19 address these impacts, these measures are not anticipated to reduce the impact to a level considered  
20 not adverse.

21 **CEQA Conclusion:** In general, Alternative 1A would reduce migration conditions for fall-/late fall-  
22 run Chinook salmon relative to the Existing Conditions.

## 23 **Upstream of the Delta**

### 24 ***Sacramento River***

#### 25 *Fall-Run*

26 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February  
27 through May under A1A\_LLT would generally be similar to or greater than those under Existing  
28 Conditions, except in wet water years during May (14% lower) (Appendix 11C, *CALSIM II Model*  
29 *Results utilized in the Fish Analysis*).

30 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
31 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
32 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
33 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
34 Existing Conditions and Alternative 1A in any month or water year type throughout the period.

35 Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run  
36 Chinook salmon upstream migration period (September through October). Flows under A1A\_LLT  
37 would generally be or lower than those under Existing Conditions during September (up to 24%  
38 lower), except for above normal years (6% greater) (Appendix 11C, *CALSIM II Model Results utilized*  
39 *in the Fish Analysis*). Flows in October would be 15% to 36% greater than Existing Conditions.

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
2 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
3 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
4 *the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would be 7% and 5%  
5 greater than those under Existing Conditions during September and October, respectively.

#### 6 *Late Fall-Run*

7 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run Chinook salmon  
8 migrants (January through March) under A1A\_LLT would be similar to or greater than flows under  
9 Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
11 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
13 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
14 Existing Conditions and Alternative 1A in any month or water year type throughout the period.

15 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon  
16 upstream migration period (December through February) under A1A\_LLT would also be similar to  
17 or greater than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in*  
18 *the Fish Analysis*).

19 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
20 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,  
21 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
22 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
23 Existing Conditions and Alternative 1A in any month or water year type throughout the period.

#### 24 **Clear Creek**

##### 25 *Fall-Run*

26 Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon  
27 upstream migration period (February through May) under A1A\_LLT would be similar to or greater  
28 than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*  
29 *utilized in the Fish Analysis*).

30 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
31 upstream migration period (September through October) under A1A\_LLT would generally be  
32 similar to or greater than those under Existing Conditions except in critical years (37% lower during  
33 September) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 Water temperature modeling was not conducted in Clear Creek.

#### 35 **Feather River**

##### 36 *Fall-Run*

37 Flows in the Feather River at the confluence with the Sacramento River during the juvenile fall-run  
38 Chinook salmon migration period (February through May) under A1A\_LLT would generally be  
39 similar to or greater than flows under Existing Conditions, except in below normal years during

1 March (11% lower) and in wet years during May (23% lower) (Appendix 11C, *CALSIM II Model*  
2 *Results utilized in the Fish Analysis*).

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
4 were examined during the February through May juvenile fall-run Chinook salmon migration period  
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
6 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
7 temperature between Existing Conditions and Alternative 1A in any month or water year type  
8 throughout the period.

9 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
10 September through October fall-run Chinook salmon adult migration period. Flows under A1A\_LLT  
11 would generally be lower (up to 27% lower) during September, except in critical years (13% greater  
12 than Existing Conditions). During October, flows under A1A\_LLT would generally be greater (up to  
13 35% greater) than flows under Existing Conditions.

14 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
15 were examined during the September through October fall-run Chinook salmon adult upstream  
16 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
17 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
18 mean monthly water temperature between Existing Conditions and Alternative 1A in any month or  
19 water year type throughout the period.

## 20 **American River**

### 21 *Fall-Run*

22 Flows in the American River at the confluence with the Sacramento River were examined during the  
23 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*  
24 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT during February, March, and April  
25 would generally be similar to or greater than flows under Existing Conditions, except for critical  
26 years during February and March (13% and 12% lower, respectively) and above normal years  
27 during April (8% lower). Flows under A1A\_LLT during May would be mostly lower by up to 27%  
28 than flows under Existing Conditions.

29 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
30 River were examined during the February through May juvenile fall-run Chinook salmon migration  
31 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
32 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
33 be 5% to 7% higher than under Existing Conditions in all month except April, in which there would  
34 be no difference.

35 Flows in the American River at the confluence with the Sacramento River were examined during the  
36 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
37 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT during September would  
38 be 44% to 58% lower than flows under Existing Conditions. Flows under A1A\_LLT during October  
39 would be 5% and 45% greater than those under Existing Conditions.

40 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
41 River were examined during the September and October adult fall-run Chinook salmon upstream  
42 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*

1 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
2 Alternative 1A would be 6% and 11% higher than those under Existing Conditions during  
3 September and October, respectively.

#### 4 **Stanislaus River**

##### 5 *Fall-Run*

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
7 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
8 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT throughout this period would  
9 generally be lower than Existing Conditions (up to 36% lower), except for March in wet water years  
10 (7% greater).

11 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
12 River were examined during the February through May juvenile fall-run Chinook salmon migration  
13 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
14 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
15 be 6% higher than those under Existing Conditions in every month of the period.

16 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
17 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
18 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be  
19 similar to flows under Existing Conditions during September, except in wet and above normal years  
20 (17% and 6% lower, respectively). During October, flows would be 6% to 11% lower depending on  
21 water year type.

22 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
23 River were examined during the September and October adult fall-run Chinook salmon upstream  
24 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
25 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
26 Alternative 1A would be 6% higher than those under Existing Conditions during September but  
27 there would be no difference in mean monthly water temperatures between Alternative 1A and  
28 Existing Conditions during October.

#### 29 **San Joaquin River**

##### 30 *Fall-Run*

31 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
32 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
33 *Analysis*). Flows under A1A\_LLT would be similar to Existing Conditions but with lower flows in two  
34 water years during February, and would be lower than Existing Conditions by up to 15% during  
35 March, April and May.

36 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
37 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
38 *in the Fish Analysis*). Flows under A1A\_LLT would be lower than Existing Conditions by up to 11%  
39 during both months.

40 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 *Fall-Run*

3 Flows in the Mokelumne River at the Delta were examined during the February through May  
4 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
5 *the Fish Analysis*). Flows under A1A\_LLT would be similar to those under Existing Conditions during  
6 February and March, but up to 18% lower than flows under Existing Conditions during April and  
7 May.

8 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
9 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
10 *in the Fish Analysis*). Flows under A1A\_LLT would be up to 29% lower than those under Existing  
11 Conditions depending on water year type.

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **Through-Delta**

14 **Sacramento River**

15 *Fall-Run*

16 Juvenile fall-run Chinook salmon migrating down the Sacramento River during February through  
17 May would generally experience lower flows below the north Delta intakes compared to Existing  
18 Conditions. During the juvenile fall-run Chinook salmon emigration period (November to early  
19 May), mean monthly flows in the Sacramento River below the north Delta intakes under Alternative  
20 1A averaged across years would be lower (up to 29% lower) compared to Existing Conditions. Flows  
21 would be up to 32% lower in March of above normal and April of below normal years. Through-  
22 Delta survival of migrating fall-run Chinook salmon smolts from the Sacramento River under  
23 Alternative 1A was fairly similar to Existing Conditions in drier and all years averaged, and lower in  
24 wetter years (5.7% lower survival, a 16% relative decrease) (Table 11-1A-48).

25 During the adult fall-run Chinook salmon upstream migration from September to December, the  
26 proportion of Sacramento River water in the Delta under Alternative 1A would be 53% to 64%.  
27 Compared to Existing Conditions, it would decrease in September (7% decrease) and December (4%  
28 decrease), and would be increase 4% in October (Table 11-1A-49).

29 *Late Fall-Run*

30 Under Alternative 1A during the juvenile migration period for late fall-run Chinook salmon, average  
31 monthly flows in the Sacramento River below the north Delta intakes averaged across all years  
32 would be 10%-31% lower from November to February, and 15% higher in October compared to  
33 Existing Conditions. Flows would decrease up to 37% in November of above normal years. Through-  
34 Delta survival rates under Alternative 1A would average 23% across all years, 27% in wetter years,  
35 and 20% in drier years (Table 11-1A-50). This would be similar to Existing Conditions averaged  
36 across years, and slightly lower in wetter years and higher in drier years (a 5-9% relative  
37 difference).

38 During the adult migration period (December to March), the percentage of water at Collinsville  
39 originating from the Sacramento River under Alternative 1A (63% to 71%) would decrease 4% to  
40 11% compared to Existing Conditions (Table 11-1A-49).

1 **Mokelumne River**

2 *Fall-Run*

3 Through-Delta survival of migrating juvenile fall-run Chinook salmon from the Mokelumne River  
4 under Alternative 1A was fairly similar in drier and all years averaged, and lower in wetter years  
5 (1.7% lower survival, a 10% relative decrease) compared to Existing Conditions (Table 11-1A-48).

6 **San Joaquin River**

7 *Fall-Run*

8 *Juveniles*

9 Through-Delta survival rates under Alternative 1A would average 23% across all years, 27% in  
10 wetter years, and 20% in drier years (Table 11-1A-48). This would be similar to NAA averaged  
11 across years, and slightly lower in wetter years and higher in drier years (a 6-7% relative  
12 difference).

13 *Adults*

14 The percentage of water at Collinsville originating from the San Joaquin River is small (no more than  
15 1% under NAA) during the fall-run migration period (September to December). Olfactory cues for  
16 fall-run Chinook migrating to the San Joaquin River under Alternative 1A (0.6 to 2.7%) would be  
17 increased compared to Existing Conditions (Table 11-1A-49).

18 **Summary of CEQA Conclusion**

19 Overall, the results indicate that the effect of Alternative 1A is adverse because it has the potential to  
20 substantially decrease fall- and late fall-run Chinook salmon migration habitat conditions upstream  
21 of the Delta. In addition, this alternative is adverse due to the cumulative effects associated with five  
22 north Delta intake facilities, including mortality related to near-field effects (e.g. impingement and  
23 predation) and far-field effects (reduced survival due to reduced flows downstream of the intakes)  
24 associated with the five NDD intakes.

25 Upstream of the Delta, flows in the American, Stanislaus, San Joaquin, and Mokelumne rivers would  
26 be lower and water temperatures in the American and Stanislaus rivers would be elevated during  
27 substantial portions of the fall-/late fall-run Chinook salmon migration periods. In the Delta, the  
28 impact on emigrating juveniles would be significant due to the impacts associated with predation  
29 and habitat loss from the five intakes under this alternative (similar to the previous description  
30 under Impact AQUA-42). Implementation of CM6 and CM15 would address these impacts, but are  
31 not anticipated to reduce them to a level considered less than significant. Although implementation  
32 of *CM6 Channel Margin Enhancement* would provide habitat similar to that which would be lost, it  
33 would not necessarily be located near the intakes and therefore would not fully compensate for the  
34 lost habitat. Additionally, implementation of this measure would not fully address predation losses.  
35 *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has substantial uncertainties  
36 associated with its effectiveness such that it is considered to have no demonstrable effect.  
37 Conservation measures that address habitat and predation losses, therefore, would potentially  
38 minimize impacts to some extent but not to a less than significant level. Consequently, as a result of  
39 these changes in migration conditions, this impact is significant and unavoidable.

1 Applicable conservation measures are briefly described below and full descriptions are found in  
2 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
3 Reduction of Predatory Fishes (Predator Control) (CM15).

4 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
5 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
6 habitats on the waterside side of levees along channels that provide rearing and outmigration  
7 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
8 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
9 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
10 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
11 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
12 margin enhancement would be performed only along channels that provide rearing and  
13 outmigration habitat for juvenile salmonids. These include channels that are protected by  
14 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
15 among several others.

16 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
17 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
18 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
19 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
20 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
21 Therefore, this conservation measure is not intended to entirely remove predators at any  
22 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
23 conservation measure would also not remove piscivorous birds. Because of uncertainties  
24 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
25 projects and research actions coupled with an adaptive management and monitoring program to  
26 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
27 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
28 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

29 This impact is a result of the specific reservoir operations and resulting flows associated with this  
30 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
31 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
32 change the alternative, thereby making it a different alternative than that which has been modeled  
33 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
34 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
35 severity of impact though not necessarily to a less-than-significant level.

36 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
37 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
38 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

39 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
40 significant and unavoidable adverse effects on migration habitat, this conclusion was based on  
41 the best available scientific information at the time and may prove to have been over- or  
42 understated. Upon the commencement of operations of CM1 and continuing through the life of  
43 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
44 whether such effects would be as extensive as concluded at the time of preparation of this

1 document and to determine any potentially feasible means of reducing the severity of such  
2 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
3 consistent with the operational framework for Alternative 1A.

4 The development and implementation of any mitigation actions shall be focused on those  
5 incremental effects attributable to implementation of Alternative 1A operations only.  
6 Development of mitigation actions for the incremental impact on migration habitat attributable  
7 to climate change/sea level rise are not required because these changed conditions would occur  
8 with or without implementation of Alternative 1A.

9 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
10 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
11 **of CM1**

12 Following commencement of initial operations of CM1 and continuing through the life of the  
13 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
14 modified operations could reduce impacts to migration habitat under Alternative 1A. The  
15 analysis required under this measure may be conducted as a part of the Adaptive Management  
16 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

17 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
18 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
19 **Migration Conditions Consistent with CM1**

20 In order to determine the feasibility of reducing the effects of CM1 operations on fall-run/late  
21 fall-run Chinook salmon habitat, the BDCP proponents will consult with USFWS and the  
22 Department of Fish and Wildlife to identify and implement any feasible operational means to  
23 either effects on migration habitat. Any such action will be developed in conjunction with the  
24 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-  
25 78a.

26 If feasible means are identified to reduce impacts on migration habitat consistent with the  
27 overall operational framework of Alternative 1A without causing new significant adverse  
28 impacts on other covered species, such means shall be implemented. If sufficient operational  
29 flexibility to reduce effects on fall-run/late fall-run Chinook salmon habitat is not feasible under  
30 Alternative 1A operations, achieving further impact reduction pursuant to this mitigation  
31 measure would not be feasible under this Alternative, and the impact on fall-run/late fall-run  
32 Chinook salmon would remain significant and unavoidable.

33 **Restoration Measures (CM2, CM4–CM7, and CM10)**

34 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-**  
35 **/Late Fall-Run ESU)**

36 Please refer to Impact AQUA-43 for winter-run Chinook salmon.

37 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**  
38 **Salmon (Fall-/Late Fall-Run ESU)**

39 Please refer to Impact AQUA-44 for winter-run Chinook salmon.

1 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**  
2 **Run ESU)**

3 Please refer to Impact AQUA-45 for winter-run Chinook salmon.

4 **Other Conservation Measures (CM12–CM19 and CM21)**

5 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**  
6 **Run ESU) (CM12)**

7 Please refer to Impact AQUA-46 for winter-run Chinook salmon.

8 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
9 **(Fall-/Late Fall–Run ESU) (CM13)**

10 Please refer to Impact AQUA-47 for winter-run Chinook salmon.

11 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**  
12 **/Late Fall–Run ESU) (CM14)**

13 Please refer to Impact AQUA-66 for spring-run Chinook salmon.

14 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-**  
15 **/Late Fall–Run ESU) (CM15)**

16 Please refer to Impact AQUA-49 for winter-run Chinook salmon.

17 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**  
18 **Run ESU) (CM16)**

19 Please refer to Impact AQUA-50 for winter-run Chinook salmon.

20 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run**  
21 **ESU) (CM17)**

22 Please refer to Impact AQUA-51 for winter-run Chinook salmon.

23 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run**  
24 **ESU) (CM18)**

25 Please refer to Impact AQUA-52 for winter-run Chinook salmon.

26 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
27 **Fall–Run ESU) (CM19)**

28 Please refer to Impact AQUA-53 for winter-run Chinook salmon.

29 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
30 **(Fall-/Late Fall–Run ESU) (CM21)**

31 Please refer to Impact AQUA-54 for winter-run Chinook salmon.

## 1 **Steelhead**

### 2 **Construction and Maintenance of CM1**

#### 3 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

4 Steelhead could be present in the vicinity of the intake and barge landings during in-water  
5 construction. The potential for exposure of steelhead to construction-related activities is expected to  
6 be low and would be limited to two construction seasons (one for installation of cofferdams and  
7 barge landings, and one for removal of cofferdams and barge landings). Adult steelhead could be  
8 present at the intake sites at the beginning of the upstream migration period in September and  
9 October (see Table 11-4). Late-migrating juveniles could also be in the vicinity of the intake  
10 locations in June. Juvenile steelhead may be in the vicinity of the barge landings during construction.  
11 Appendix 11A, *Covered Fish Species* details the temporal and spatial distribution of various life  
12 history stages for steelhead.

#### 13 ***Temporary Increases in Turbidity***

14 Low numbers of steelhead may be exposed to increased levels of turbidity during in-water  
15 construction at the intakes and barge landings (see Table 11-4). Potential effects on steelhead from  
16 temporary increases in turbidity are similar to those described for Chinook salmon (see Impact  
17 AQUA-37). The extent of adverse effects would be avoided and minimized by implementing the  
18 environmental commitments *Environmental Training; Stormwater Pollution Prevention Plan; Erosion*  
19 *and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment,*  
20 *and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* and  
21 *Barge Operations Plan*. Pertinent measures included in these plans are discussed under Impact  
22 AQUA-1 for delta smelt.

#### 23 ***Accidental Spills***

24 Potential effects on steelhead from accidental spills are similar to those described for delta smelt  
25 (see Impact AQUA-1). Depending on the type and magnitude of an accidental spill, contaminants can  
26 directly affect the growth and survival of steelhead. Implementation of the environmental  
27 commitments discussed for delta smelt (see Impact AQUA-1) and contained in Appendix 3B,  
28 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
29 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
30 *Containment, and Countermeasure Plan)*, specifically the *Spill Prevention, Containment, and*  
31 *Countermeasure Plan*, would minimize the potential for introduction of contaminants to surface  
32 waters and provide for effective containment and cleanup should accidental spills occur. Pertinent  
33 measures included in these plans are discussed under Impact AQUA-1 for delta smelt.

#### 34 ***Disturbance of Contaminated Sediments***

35 Toxic contaminants are present in both water and sediment in the Delta aquatic environment, as  
36 described in Chapter 8, *Water Quality*. In-water construction activities would suspend sediments  
37 that may contain toxic contaminants (see discussion under Impact AQUA-1 for delta smelt).  
38 Potential effects on steelhead from disturbance of contaminated sediments during construction are  
39 similar to those described for delta smelt (Impact AQUA-1). Effects would be minimized by  
40 implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
41 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*

1 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
2 *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*  
3 *Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan).*

#### 4 **Underwater Noise**

5 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
6 steelhead. It is important to note that the impact would be realized only where piles must be impact  
7 driven; underwater sound generated by vibratory pile installation methods are not sufficiently loud  
8 to injure fish.

9 Potential effects on steelhead from impact pile driving are similar to those described for Chinook  
10 salmon (see Impact AQUA-37). Table 11-4 illustrates the life stages of steelhead expected to be  
11 present in the north, east, and south Delta during the in-water construction window (expected to be  
12 June 1–October 31). Central Valley steelhead eggs and fry would not experience underwater sound  
13 from pile driving because the locations of the intakes and barge landings are not considered suitable  
14 habitat for these two life stages of this species; therefore, effects would not occur.

15 Adult Central Valley steelhead could be present near the construction areas of the intakes and barge  
16 landings during June and July. Adults use the Sacramento and San Joaquin Rivers on their migration  
17 to upriver spawning areas during spring and summer. However, densities of the adults would be  
18 very low, as June and July do not overlap with peak migration periods. Steelhead could be  
19 moderately abundant near the construction areas for intakes in October. Adult steelhead are large  
20 and are able to avoid injurious exposure to underwater noise from pile driving. They may  
21 experience short delays in migration past the intakes when pile driving is occurring; however, pile  
22 driving would occur only intermittently through a portion of the day, and minor migration delays  
23 would not affect their ability to successfully reach spawning grounds. Therefore, the potential for  
24 adult Central Valley steelhead to experience an adverse effect (e.g., injury or mortality, or migratory  
25 disturbance) would be low because of their size, ability to move away from the underwater sound,  
26 and their potentially low to moderate temporal and spatial migration distribution around the  
27 construction areas.

28 Juvenile steelhead that have migrated downriver could be moderately abundant in the vicinity of the  
29 intakes and barge landings during June and July. The habitat in these areas is considered poor  
30 because of relatively steep rip rap banks and deep channels with little refuge, which may limit their  
31 overall abundance in these areas. Although it is not possible to predict the number of steelhead that  
32 would be exposed to underwater sound at the construction locations, underwater noise could  
33 exceed the criteria for approximately 8 to 12 hours a day for those days that impact pile driving  
34 occur.

35 If an individual juvenile steelhead were present in an area affected by underwater sound from  
36 impact pile driving above the 187-dB SEL<sub>cumulative</sub> level, and proximate to an impact-driven pile, it  
37 could experience an adverse effect, such as injury or mortality. However, because of the overall low  
38 densities of juvenile steelhead expected in all pile driving locations, the relatively low incidence of  
39 impact pile driving expected, and implementation of the avoidance and minimization measures  
40 included in Mitigation Measures AQUA-1a and AQUA-1b, the potential for juvenile steelhead to  
41 experience an adverse effect from impact pile driving (e.g., injury or mortality) would be very low.  
42 Therefore, underwater noise from impact pile driving would not adversely affect steelhead  
43 population levels.

1       **Fish Stranding**

2       The risk of fish entrapment and subsequent handling stress during removal would be minimized by  
3       limiting cofferdam construction and other in-water work to the CDFW- and NMFS- approved in-  
4       water work windows (expected to be June 1 through October 31). In addition, implementation of  
5       environmental commitment *Fish Rescue and Salvage Plan*, would also minimize impacts (see Impact  
6       AQUA-1 and Appendix 3B, *Environmental Commitments*). The typical size and swimming ability of  
7       steelhead smolts would also minimize the chances of stranding or entrapment inside of the  
8       cofferdam structures. Therefore, stranding would not be expected to adversely affect steelhead.

9       **In-Water Work Activities**

10       As discussed for delta smelt (see Impact AQUA-1), although fish would likely avoid the noise and  
11       activity of pile installation and placement of riprap protection, these activities have the potential to  
12       result in direct injury or mortality. Although low numbers of steelhead would likely be present  
13       during in-water construction activities, it is unknown how many juvenile steelhead could be  
14       affected. Effects would be minimized by implementation of environmental commitments described  
15       under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*, including  
16       *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material;*  
17       *and Barge Operations Plan.*

18       **Loss of Spawning, Rearing, or Migration Habitat**

19       There is no suitable spawning habitat for steelhead in the vicinity of the proposed in-water work;  
20       therefore steelhead spawning habitat would not be affected by construction activities. Construction  
21       would temporarily and permanently affect designated critical rearing and migration habitat for  
22       steelhead. The existing rearing habitat is of low quality, consisting of armored levees with limited  
23       riparian vegetation (see Impact AQUA-1).

24       The mainstem Sacramento River is designated as steelhead critical habitat, providing migration and  
25       rearing habitat. This includes up to about 28.7 acres temporarily lost during in-water work, and a  
26       total of approximately 22,700 linear feet of river bank affected (see Table 11-5). Construction of the  
27       approach canal and Byron Tract Forebay would not affect fish-accessible waterways and therefore  
28       would not affect steelhead. The work would be conducted in stages, with dredging at Intake 1 in  
29       June; dredging at Intakes 2, 3, and 5 in July; and dredging at Intake 4 in August of the first in-water  
30       construction year. The armored levee bank habitat that would be permanently lost would be  
31       replaced by the intake screen structures (alteration of up to 8,300 linear feet of channel margin).  
32       Some riparian trees and shrubs that currently grow on the levee banks would be lost, slightly  
33       reducing cover and shade, and the input of leaves and insects falling into the river from overhanging  
34       vegetation. However, bank armoring and lack of physical structure currently limit the quality of this  
35       habitat. Potential effects would be minimized by implementation of environmental commitments  
36       described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments.*

37       **Predation**

38       Impacts on steelhead from predation would be similar to those described for Chinook salmon (see  
39       Impact AQUA-37).

1       **Summary**

2       Potential effects of construction activities on steelhead would be similar to those discussed for  
3       Chinook salmon (Impact AQUA-37). Implementation of the environmental commitments described  
4       for Chinook salmon and in Appendix 3B, *Environmental Commitments*, would minimize effects of  
5       construction activities on steelhead from turbidity increases and inadvertent spills of hazardous  
6       materials. These environmental commitments are *Environmental Training; Stormwater Pollution*  
7       *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
8       *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
9       *and Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1 for delta  
10       smelt. As a result, these effects would not likely be adverse to steelhead.

11       The low numbers of steelhead would also minimize the potential for effects during in-water  
12       construction activities (including impact pile driving). The relatively low incidence of impact pile  
13       driving expected, and implementation of the avoidance and minimization measures included in  
14       Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from  
15       impact pile driving (e.g., injury or mortality).

16       Locally increased predator habitat and predation from the temporary construction structures  
17       (cofferdams and barge landing docks) would not have population level effects. Therefore, predation  
18       effects on steelhead from construction activities would not be adverse.

19       Although construction of the intakes and barge landings will temporarily or permanently affect  
20       critical steelhead rearing and migration habitat, the relatively poor quality of the current habitat and  
21       implementation of *CM6 Channel Margin Enhancement* would result in a net improvement in channel  
22       margin habitat function.

23       **NEPA Effects:** Overall, construction activities are not expected to adversely affect steelhead or their  
24       habitat.

25       **CEQA Conclusion:** The potential impact on steelhead from construction activities is considered less  
26       than significant due to implementation of the measures described under Impact AQUA-1 for delta  
27       smelt and in Appendix 3B, *Environmental Commitments*. These include *Environmental Training;*  
28       *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
29       *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils,*  
30       *Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations*  
31       *Plan*. These measures would be expected to protect steelhead from any adverse water quality effect  
32       (turbidity increases or spills of hazardous materials) resulting from project construction.  
33       Construction would not be expected to increase predation rates relative to NAA. Construction  
34       associated with Alternative 1A will result in both temporary and permanent alteration of rearing  
35       and migratory habitats used by steelhead. However, these impacts are not expected to be significant  
36       because the loss of habitat is not substantial compared to the amount of habitat currently available  
37       in combination with the amount of new habitat that would result from restoration.

38       Locally increased predator habitat and predation from the temporary construction structures  
39       (cofferdams and barge landing docks) would not have population level effects. Implementation of  
40       *CM6 Channel Margin Enhancement* would result in a net improvement in channel margin habitat  
41       function after construction. The direct effects of underwater construction noise on steelhead would  
42       be a significant impact because of the high likelihood that it would cause injury or death to most  
43       impacted fish in the immediate vicinity of the activity. However, implementation of Mitigation

1 Measures AQUA-1a and AQUA-1b would minimize the potential effects from underwater noise and  
2 would minimize the severity of impacts to a less-than-significant level.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

6 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
7 **and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

9 For these reasons, the impacts of construction activities on steelhead would be less than significant,  
10 and no additional mitigation would be required.

11 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

12 ***Temporary Increases in Turbidity***

13 As discussed for construction-related effects of turbidity on Chinook salmon (Impact AQUA-37),  
14 increased turbidity could result in a decreased ability to forage, a decreased ability to avoid  
15 predators, or physical injury to the gills. In-water maintenance activities would occur between  
16 typically June 1 and October 31 when steelhead are minimally present in the Sacramento River. In-  
17 water activities would be limited in duration and infrequent. Turbidity effects would be minimized  
18 by implementing the environmental commitments described under Impact AQUA-1 for delta smelt  
19 and in Appendix 3B, *Environmental Commitments*. These environmental commitments are  
20 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
21 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*  
22 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

23 ***Accidental Spills***

24 The potential effects of maintenance activities would be similar to those discussed for construction-  
25 related effects on Chinook salmon (see Impact AQUA-37). Effects would be minimized by  
26 implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
27 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
28 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; and Spill*  
29 *Prevention, Containment, and Countermeasure Plan)*. Pertinent details of these plans are provided  
30 under Impact AQUA-1 for delta smelt.

31 ***Underwater Noise***

32 As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
33 maintenance activities are not expected to reach a level that would harm juvenile or adult fishes.  
34 This effect would not be adverse because potential noise from in-water maintenance activities  
35 would not exceed the threshold sound pressure level and would be temporary. In addition, the in-  
36 water work would be conducted when the least number of steelhead are likely to be present.

1 **Maintenance-Related Disturbance**

2 Effects on steelhead from use of in-water equipment (boats, barges, and dredging equipment)  
3 during maintenance would be the same as those discussed for delta smelt (see Impact AQUA-2).  
4 Direct injury and mortality of steelhead are most likely to occur during dredging activities around  
5 the new intakes. Suction dredging and mechanical excavation can capture or crush fish, causing  
6 injury or mortality. In-water dredging would occur during months when steelhead are minimally  
7 present in the Sacramento River, and dredging would be of short duration. Furthermore, effects  
8 would be minimized by implementation of environmental commitments including *Environmental*  
9 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
10 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Barge*  
11 *Operations Plan*, described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
12 *Commitments*.

13 **Loss of Spawning, Rearing, or Migration Habitat**

14 Steelhead habitat near the intake structures would be limited to rearing and migration. A small area  
15 of rearing habitat could be affected due to periodic dredging or placement of riprap. Migration  
16 habitat would be available farther out in the channel and would be unaffected by dredging and  
17 riprap placement. Available rearing and migration habitat of similar quantity and quality would be  
18 readily accessible to steelhead in the immediate vicinity of maintenance activities. Potential effects  
19 would be minimized by implementation of environmental commitments described under Impact  
20 AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*.

21 **Predation**

22 Effects on steelhead from predation during construction would be similar to those described for  
23 winter-run Chinook salmon (see Impact AQUA-37 for winter-run Chinook salmon).

24 **Summary**

25 In-water maintenance activities would be scheduled to occur when the least numbers of steelhead  
26 would be present in or near the maintenance areas. Such activities would include maintenance  
27 dredging at the intake sites, and installation or repair of riprap bank armoring. Implementation of  
28 the environmental commitments described in Appendix 3B, *Environmental Commitments*, would  
29 further minimize or eliminate effects on Chinook salmon. These include *Environmental Training;*  
30 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
31 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
32 *Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans are provided under  
33 Impact AQUA-1 for delta smelt.

34 Implementation of these environmental commitments, along with the low numbers of steelhead  
35 expected to occur in the maintenance areas during the approved in-water work windows and the  
36 limited frequency and duration of in-water maintenance activities, would result in a very low  
37 potential for adverse effects on steelhead from turbidity increases or spills of hazardous materials.  
38 In addition, no spawning habitat occurs in the areas potentially affected by maintenance activities,  
39 and ample rearing, and migration habitat of the same quality is readily accessible in the area, and  
40 this habitat would not be affected by maintenance activities.

41 **NEPA Effects:** The short-term maintenance activities would not adversely affect steelhead.

1 **CEQA Conclusion:** In addition to the limited frequency and duration of in-water maintenance  
2 activities, implementation of environmental commitments identified above and described in detail  
3 in Appendix 3B, *Environmental Commitments*, would minimize the potential for maintenance  
4 activities to affect steelhead through increases in turbidity or spills of hazardous materials. These  
5 environmental commitments, described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
6 *Environmental Commitments*, include *Environmental Training; Stormwater Pollution Prevention*  
7 *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
8 *Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and*  
9 *Dredged Material*. Potential changes to rearing and migratory habitat would also be limited and  
10 temporary. Therefore, the potential impact of maintenance activities is considered less than  
11 significant because it would not substantially interfere with its movement. Consequently, no  
12 mitigation would be required.

### 13 **Water Operations of CM1**

14 Numerous methods were used to estimate entrainment losses under Alternative 1A compared to  
15 NAA (refer to *Methods for Analysis* in this chapter). A complete analysis can be found in the *BDCP*  
16 *Effects Analysis – Appendix 5B, Entrainment (hereby incorporated by reference)*. In general and using  
17 a variety of methods, the difference between NAA and Alternative 1A varies across water-year types  
18 and species.

### 19 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

#### 20 ***Water Exports from SWP/CVP South Delta Facilities***

21 An entrainment index of winter-run Chinook salmon at the South Delta facilities was estimated  
22 using the salvage-density method (as detailed in *BDCP Effects Analysis - Appendix 5.B, Section 5.B.4,*  
23 *herein incorporated by reference*). Under NAA, entrainment peaks in February at both SWP and CVP  
24 facilities and is also relatively high in January and March. Estimated losses for juvenile steelhead  
25 were approximately four times greater at the SWP export facilities compared to the CVP export  
26 facilities, with losses at both facilities generally from 1,000 to 10,000 fish per year. Losses were  
27 greatest in above-normal and below-normal years, and least in critical water years.

28 Annual entrainment loss of juvenile steelhead across all years decreased 56% under Alternative 1A  
29 compared to baseline (Table 11-1A-51). Entrainment would decrease most in wet (85% decrease),  
30 above-normal (66% decrease), and below-normal years (56% decrease). Entrainment of juvenile  
31 steelhead in dry and critical years generally would be similar under Alternative 1A to NAA.

1 **Table 11-1A-51. Juvenile Steelhead Annual Entrainment at the SWP and CVP Salvage Facilities—**  
2 **Differences between Model Scenarios for Alternative 1**

Water Year	Absolute Difference (Percent Difference)	
	Existing Conditions vs. A1A_LLT	NAA vs. A1A_LLT
Wet	-5,259 (-84%)	-5,352 (-85%)
Above Normal	-8,883 (-68%)	-9,227 (-69%)
Below Normal	-6,393 (-54%)	-5,662 (-51%)
Dry	-699 (-9%)	-108 (-2%)
Critical	-212 (-4%)	139 (3%)
All Years	-6,569 (-59%)	-6,381 (-58%)

Shading indicates 10% or greater increased entrainment.

Note: Estimated annual number of fish lost, based on normalized data.

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 Potential entrainment of juvenile steelhead at the north Delta intakes occurs only under the action  
6 alternatives, including Alternative 1A, because there are no north Delta intakes operational under  
7 NAA. The north Delta intakes would be screened to exclude juvenile fish and are expected to be  
8 effective at excluding juvenile steelhead. The screens will be designed and built to specifications that  
9 are developed to reduce the risk of entrainment and impingement. Steelhead juveniles are larger  
10 than Chinook juveniles and would be less vulnerable to entrainment. The project’s adaptive  
11 management plan includes monitoring of the new screens to determine their effectiveness. If the  
12 screens are not meeting expectations additional measures may be implemented to improve screen  
13 performance such as modifications to the screens or other structural components at the intakes, or  
14 changes in water diversion operations to reduce entrainment or impingement rates of juvenile  
15 steelhead.

16 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

17 Entrainment of juvenile steelhead at the North Bay Aqueduct has not been explicitly analyzed.  
18 However, changes at the NBA Barker Slough Pumping Plant would have minimal effect because  
19 steelhead are not present in this area and therefore have minimal risk of entrainment under Existing  
20 Conditions. Entrainment at the proposed NBA alternative intake would be expected to be minimal  
21 because the intake would be 100% screened based on typical fish size and mesh size. Monitoring  
22 would occur to ensure that fish are indeed being excluded according to the design specifications. If  
23 monitoring indicates that screen effectiveness is not meeting expectations, the BDCP-proposed Real-  
24 Time Response Team would implement additional measures to reduce entrainment or  
25 impingement, such as modifications to the screens or intakes, or changes in water diversion  
26 operations.

27 **NEPA Effects:** Juvenile steelhead entrainment would decrease substantially overall (greater than  
28 50% decrease Juvenile steelhead entrainment at the south Delta facilities would decrease  
29 substantially (56% decrease across all water years) compared to NAA. Entrainment risk at the north  
30 Delta intakes and North Bay Aqueduct would be minimized due to screening. Therefore this effect is  
31 expected to be generally beneficial to the species.

1 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
2 SWP/CVP south Delta facilities would result in an overall decrease in entrainment for juvenile  
3 steelhead. At the same time, operational activities associated with water exports from SWP/CVP  
4 north Delta intake facilities would result in an increase in entrainment or a loss of individuals at that  
5 location. However, because the intakes would be equipped with state-of-the-art screens,  
6 entrainment is expected to be reduced as a whole. Potential impacts of Alternative 1A water  
7 operations on entrainment of steelhead would be beneficial due to an overall reduction in  
8 entrainment which is beneficial to the population. Consequently, no mitigation would be required.

9 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
10 **Steelhead**

11 In general, Alternative 1A would not affect steelhead spawning and egg incubation habitat relative  
12 to NAA.

13 **Sacramento River**

14 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where  
15 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning  
16 and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized*  
17 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg  
18 incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under  
19 A1A\_LLТ throughout the period would be similar to or greater than flows under NAA during this  
20 period, except in critical water years during January (11% lower).

21 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
22 examined during the January through April primary steelhead spawning and egg incubation period  
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
24 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
25 temperature between NAA and Alternative 1A in any month or water year type throughout the  
26 period at either location

27 SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning  
28 availability, measured as weighted usable area, under A1A\_LLТ relative to NAA (Table 11-1A-52).  
29 SacEFT predicts that there would be a negligible (<5%) difference in the percentage of years with  
30 good (lower) redd scour risk, and no (0%) differences in the percentage of years with good (lower)  
31 egg incubation conditions, under A1A\_LLТ relative to NAA. SacEFT predicts that there would be a  
32 13% increase in the risk of redd dewatering attributable to the project.

1 **Table 11-1A-52. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
2 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	-3 (-4%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	4 (7%)	7 (13%)
Juvenile Rearing WUA	-4 (-10%)	-8 (-18%)
Juvenile Stranding Risk	-19 (-56%)	-5 (-25%)

WUA = Weighted Usable Area.

3

4 **Clear Creek**

5 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period  
6 (January through April). Flows under A1A\_LLT would generally be similar to flows under NAA  
7 throughout the period, (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest  
9 monthly flow reduction would be identical between NAA and A1A\_LLT for all water year types  
10 (Table 11-1A-53).

11 **Table 11-1A-53. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**  
12 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**  
13 **Incubation Period<sup>a</sup>**

Water Year Type	A1A_LLT vs. EXISTING CONDITIONS	A1A_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

14

15 No water temperature modeling was conducted in Clear Creek.

16 **Feather River**

17 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and  
18 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation  
19 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
20 Flows in the low-flow channel under A1A\_LLT would not differ from NAA because minimum Feather  
21 River flows are included in the FERC settlement agreement and would be met for all model  
22 scenarios (California Department of Water Resources 2006). Flows under A1A\_LLT at Thermalito

1 Afterbay would generally be greater by up to 82% than flows under NAA, except in critical years  
2 during January (15% lower).

3 Oroville Reservoir storage volume at the end of September and end of May influences flows  
4 downstream of the dam during the steelhead spawning and egg incubation period. Storage volume  
5 at the end of September under A1A\_LLT would be 18% to 31% greater than storage under NAA  
6 depending on water year type (Table 11-2A-27). May Oroville storage under A1A\_LLT would be  
7 similar to storage under NAA in all water years except dry, in which flows would be 5% greater than  
8 storage under NAA (Table 11-2A-30).

9 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito  
10 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January  
11 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River  
12 Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
13 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative  
14 1A in any month or water year type throughout the period at either location.

15 The percent of months exceeding the 56°F temperature threshold in the Feather River above  
16 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-1A-  
17 54). The percent of months exceeding the threshold under Alternative 1A would generally be similar  
18 to or lower (up to 12% lower on an absolute scale) than the percent under NAA depending on  
19 month and degrees above the threshold.

20 **Table 11-1A-54. Differences between Baseline and Alternative 1A Scenarios in Percent of Months**  
21 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
22 **River above Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LLT</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	5 (400%)	2 (NA)	1 (NA)	1 (NA)	0 (NA)
April	35 (400%)	15 (300%)	12 (NA)	4 (NA)	0 (NA)
<b>NAA vs. A1A_LLT</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-4 (-38%)	0 (0%)	0 (0%)	0 (0%)	-1 (-100%)
April	-10 (-19%)	-12 (-38%)	-5 (-29%)	-2 (-40%)	-1 (-100%)

NA = could not be calculated because the denominator was 0.

23  
24 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito  
25 Afterbay (low-flow channel) during January through April (Table 11-1A-55). Total degree-months  
26 would be similar between NAA and Alternative 1A in all months.

1 **Table 11-1A-55. Differences between Baseline and Alternative 1A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 56°F in the Feather River above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	3 (NA)	1 (50%)
	Critical	9 (900%)	1 (11%)
	All	14 (1,400%)	2 (15%)
April	Wet	5 (NA)	2 (67%)
	Above Normal	12 (600%)	1 (8%)
	Below Normal	14 (350%)	-2 (-10%)
	Dry	22 (440%)	-4 (-13%)
	Critical	21 (NA)	-2 (-9%)
	All	74 (673%)	-5 (-6%)

NA = could not be calculated because the denominator was 0.

4

5 **American River**

6 Flows in the American River at the confluence with the Sacramento River were examined for the  
 7 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
 8 *Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for  
 9 spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality.  
 10 Flows under A1A\_LLT would generally be similar to flows under NAA during the period except in  
 11 dry and critical years during March (9% lower in both years) (Appendix 11C, *CALSIM II Model*  
 12 *Results utilized in the Fish Analysis*).

13 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
 14 during the January through April steelhead spawning and egg incubation period ((Appendix 11D,  
 15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 17 NAA and Alternative 1A in any month or water year type throughout the period.

1 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
2 Avenue Bridge was evaluated during November through April (Table 11-1A-44). Steelhead spawn  
3 and eggs incubate in the American River between January and April. During this period, the percent  
4 of months exceeding the threshold under Alternative 1A would similar to or up to 12% lower  
5 (absolute scale) than the percent under NAA.

6 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
7 Avenue Bridge during November through April (Table 11-1A-45). During the January through April  
8 steelhead spawning and egg incubation period, total degree-months would be similar between NAA  
9 and Alternative 1A.

#### 10 **Stanislaus River**

11 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
12 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
13 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LL1 throughout this period would  
14 generally be identical to flows under NAA.

15 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative  
16 1A throughout the January through April steelhead spawning and egg incubation period (Appendix  
17 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
18 *the Fish Analysis*).

#### 19 **San Joaquin River**

20 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 21 **Mokelumne River**

22 Flows in the Mokelumne River at the Delta were examined during the January through April  
23 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
24 *Fish Analysis*). Flows under A1A\_LL1 throughout this period would generally be identical to flows  
25 under NAA.

26 Water temperature modeling was not conducted in the Mokelumne River.

27 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it  
28 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish  
29 as a result of egg mortality. There would be very few reductions in flows under Alternative 1A  
30 during the period examined in each waterway. Flows would improve in the Feather River and the  
31 exceedance of NMFS temperature thresholds would be reduced under Alternative 1A.

#### 32 **CEQA Conclusion:**

33 In general, Alternative 1A would not affect the quantity and quality of steelhead spawning habitat  
34 relative to the Existing Conditions due to substantial increased exposure to elevated water  
35 temperatures in the Feather and American Rivers and reductions in mean monthly flows in the  
36 Stanislaus River.

#### 37 **Sacramento River**

38 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where  
39 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning

1 and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized*  
2 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg  
3 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows  
4 under A1A\_LLT would generally be similar to flows under Existing Conditions during January,  
5 March, and April, and up to 16% higher than flows under Existing Conditions during February with  
6 some exceptions. Upstream of Red Bluff Diversion Dam, flows under A1A\_LLT would generally be  
7 similar to flows under Existing Conditions during February through April and higher by up to 13%  
8 than flows under Existing Conditions during January.

9 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
10 examined during the January through April primary steelhead spawning and egg incubation period  
11 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
12 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
13 temperature between Existing Conditions and Alternative 1A in any month or water year type  
14 throughout the period at either location.

15 SacEFT predicts no changes (0% difference) in spawning habitat and egg incubation conditions for  
16 Alternative 1A compared to Existing Conditions (Table 11-1A-16). SacEFT predicts that there would  
17 be a small (7%) reduction in the percent of years with good (lower) redd scour risk under A1A\_LLT  
18 relative to Existing Conditions. SacEFT predicts that there would be a 7% increase in the risk of redd  
19 dewatering under A1A\_LLT relative to Existing Conditions.

#### 20 **Clear Creek**

21 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period  
22 (January through April). Flows under A1A\_LLT would be similar to or greater than flows under  
23 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*  
24 *Fish Analysis*).

25 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest  
26 monthly flow reduction would be identical between Existing Conditions and A1A\_LLT for all water  
27 year types except wet, in which the greatest reduction would be 38% lower (worse) under A1A\_LLT  
28 than under Existing Conditions (Table 11-1A-53).

29 No water temperature modeling was conducted in Clear Creek.

#### 30 **Feather River**

31 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and  
32 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation  
33 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
34 Flows in the low-flow channel under A1A\_LLT would not differ from Existing Conditions because  
35 minimum Feather River flows are included in the FERC settlement agreement and would be met for  
36 all model scenarios (California Department of Water Resources 2006). Flows under A1A\_LLT at  
37 Thermalito Afterbay would generally be similar to or greater than flows under Existing Conditions,  
38 except in above and below normal water years during January (37 and 40% lower, respectively),  
39 below normal years during February (16% lower), and below normal water years during March  
40 (31% lower, respectively).

41 Oroville Reservoir storage volume at the end of September and end of May influences flows  
42 downstream of the dam during the steelhead spawning and egg incubation period. Oroville

1 Reservoir storage volume at the end of September would be up to 21% lower under A1A\_LLT  
2 relative to Existing Conditions depending on water year type except in dry and critical years, in  
3 which storage would be similar to Existing Conditions (Table 11-1A-27). May Oroville storage  
4 volume under A1A\_LLT would be lower than Existing Conditions by 7% to 15% depending on water  
5 year type, except in wet years, in which storage would be similar to Existing Conditions (Table 11-  
6 1A-30).

7 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito  
8 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January  
9 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*  
10 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the  
11 low-flow channel, mean monthly water temperatures under Alternative 1A would be 5% to 7%  
12 greater than those under Existing Conditions during January through March and similar to  
13 temperatures under Existing Conditions during April. In the high-flow channel, mean monthly water  
14 temperatures under Alternative 1A would be 6% greater than those under Existing Conditions  
15 during January and February and similar to temperatures under Existing Conditions during March  
16 and April.

17 The percent of months exceeding the 56°F temperature threshold in the Feather River above  
18 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-1A-  
19 54). The percent of months exceeding the threshold under Alternative 1A would generally be similar  
20 to the percent under Existing Conditions during January and February and similar to or up to 35%  
21 greater (absolute scale) than the percent under NAA depending on month and degrees above the  
22 threshold.

23 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito  
24 Afterbay (low-flow channel) during January through April (Table 11-1A-55). Total degree-months  
25 would be similar between Existing Conditions and Alternative 1A during January and February and  
26 673% to 1400% higher under Alternative 1A compared to Existing Conditions during March and  
27 April.

### 28 ***American River***

29 Flows in the American River at the confluence with the Sacramento River were examined for the  
30 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
31 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be lower by up to  
32 27% than flows under Existing Conditions during January, greater by up to 29% than flows under  
33 Existing Conditions during February and March, and similar to flows under Existing Conditions  
34 during April with few exceptions.

35 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
36 during the January through April steelhead spawning and egg incubation period (Appendix 11D,  
37 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
38 *Fish Analysis*). Mean monthly water temperature under Alternative 1A would be 5% to 7% higher  
39 than those under Existing Conditions during January through March, and temperatures would not  
40 differ between Alternative 1A and Existing Conditions during April.

41 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
42 Avenue Bridge was evaluated during November through April (Table 11-1A-44). Steelhead spawn  
43 and eggs incubate in the American River between January and April. During January and February,

1 the percent of month exceeding the threshold under Existing Conditions and Alternative 1A would  
2 be identical. During March and April, the percent of months exceeding the threshold under  
3 Alternative 1A would be up to 30% greater (absolute scale) than the percent under Existing  
4 Conditions.

5 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
6 Avenue Bridge during November through April (Table 11-1A-45). During the January and February,  
7 there would be no difference in total degree-months above the threshold between Existing  
8 Conditions and Alternative 1A. During March and April, total degree-months under Alternative 1A  
9 would be 384% and 92% greater than those under Existing Conditions, respectively.

#### 10 ***Stanislaus River***

11 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
12 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
13 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT throughout this period would be up  
14 to 36% lower flows under Existing Conditions in all months with few exceptions.

15 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was  
16 evaluated during the January through April steelhead spawning and egg incubation period  
17 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
18 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would be 6%  
19 higher than those under Existing Conditions in all months.

#### 20 ***San Joaquin River***

21 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 22 ***Mokelumne River***

23 Flows in the Mokelumne River at the Delta were examined during the January through April  
24 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
25 *Fish Analysis*). Flows under A1A\_LLT would generally be similar to flows under Existing Conditions  
26 during January through March and up to 14% lower during April.

27 Water temperature modeling was not conducted in the Mokelumne River.

#### 28 **Summary of CEQA Conclusion**

29 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between  
30 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
31 alternative could substantially reduce suitable spawning habitat or substantially reduce the number  
32 of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Temperatures in  
33 the Feather and American Rivers would increase such that the extent of exceeding NMFS thresholds  
34 would increase substantially. In addition, flows in the Stanislaus River would be lower under  
35 Alternative 1A throughout the steelhead spawning and egg incubation period. There would  
36 generally be negligible effects of Alternative 1A on steelhead spawning and egg incubation in the  
37 Sacramento River.

38 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
39 change, future water demands, and implementation of the alternative. The analysis described above  
40 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of

1 the alternative from those of sea level rise, climate change and future water demands using the  
2 model simulation results presented in this chapter. However, the increment of change attributable  
3 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
4 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
5 implementation period, which does include future sea level rise, climate change, and water  
6 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
7 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
8 effect of the alternative from those of sea level rise, climate change, and water demands.

9 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
10 term implementation period and Alternative 1A indicates that flows in the locations and during the  
11 months analyzed above would generally be similar between Existing Conditions during the LLT and  
12 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
13 found above would generally be due to climate change, sea level rise, and future demand, and not  
14 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
15 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
16 result in a significant impact on spawning and egg incubation habitat for steelhead. This impact is  
17 found to be less than significant and no mitigation is required.

#### 18 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

19 In general, Alternative 1A would not affect the quantity or quality of steelhead rearing habitat  
20 relative to NAA.

#### 21 ***Sacramento River***

22 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream  
23 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in  
24 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the  
25 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to  
26 upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
27 Analysis*). Flows during October and between December and July under A1A\_LLTT would generally be  
28 similar to or greater than those under NAA. Flows during August, September, and November would  
29 generally be lower (by up to 45%) under A1A\_LLTT than under NAA.

30 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
31 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River  
32 Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
33 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative  
34 1A in any month or water year type throughout the period at either location.

35 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions  
36 under A1A\_LLTT would be 18% lower than that under NAA (Table 11-1A-52). Also, the percentage of  
37 years with good (lower) juvenile stranding risk conditions under A1A\_LLTT would be 25% lower  
38 than under NAA. These results indicate that Alternative 1A would cause a moderate decrease in  
39 rearing habitat conditions and increase in juvenile mortality risk resulting from stranding in the  
40 Sacramento River.

**Clear Creek**

Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under A1A\_LLТ would generally be similar to or greater than flows under NAA, except in critical years during June and September, in which flows would be 8% and 13% lower, respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

It was assumed that habitat for juvenile steelhead rearing would be constrained by the month having the lowest instream flows. Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream flows affecting juvenile rearing habitat are shown in Table 11-1A-56.

Results predict that Alternative 1A would generally have no effect on juvenile rearing habitat, based on minimum instream flows, compared to NAA with the exception of increases in below normal (86%) and dry (575%) water years, which would have beneficial effects.

**Table 11-1A-56. Minimum Monthly Instream Flow (cfs) for Alternative 1A Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLТ	NAA vs. A1A_LLТ
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	15 (21%)	39 (86%)
Dry	0 (0%)	43 (575%)
Critical	-50 (-100%)	0 (NA)

Note: Minimum flows occurred between October and March.

NA = could not be calculated because the denominator was 0.

Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-1A-4). The current Clear Creek management regime uses flows slightly lower than those recommended by Denton. Results from a new IFIM study on Clear Creek are currently being analyzed. Depending on results of this study the flow regime could be adjusted in the future. We expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek. No change in effect on steelhead in Clear Creek is anticipated.

**Feather River**

Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). Relatively constant flows in the low-flow channel throughout the year under A1A\_LLТ would not differ from those under NAA. In the high-flow channel, flows under A1A\_LLТ would be mostly greater by up to 110% than flows under NAA during November through June with few exceptions during which flows would be similar to, or up to 15% lower, than under NAA.

1 May Oroville storage under A1A\_LLT would be similar to storage under NAA, except for dry years  
2 (5% higher) (Table 11-1A-30).

3 As reported for Alternative 1A (Impact AQUA-58 for spring-run Chinook salmon), September  
4 Oroville storage volume would be 18% to 31% greater than under NAA depending on water year  
5 type (Table 11-1A-27).

6 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
7 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
8 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature  
9 Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
10 water temperature between NAA and Alternative 1A in any month or water year type throughout  
11 the period at either location.

12 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in  
13 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and  
14 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-  
15 flow channel, the percent of months exceeding the threshold under Alternative 1A would generally  
16 be similar to or lower (up to 19% lower on an absolute scale) than the percent under NAA (Table  
17 11-1A-31). At Gridley, the percent of months exceeding the threshold under Alternative 1A would  
18 similar to or up to 20% lower (absolute scale) than the percent under NAA (Table 11-1A-41).

19 Total degree-months exceeding 56°F were summed by month and water year type in the Feather  
20 River above Thermalito Afterbay (low-flow channel) and at Gridley during November through April.  
21 In the low-flow channel, total degree-months under Alternative 1A would be similar to or lower than  
22 those under NAA depending on the month (Table 11-1A-32). At Gridley, total degree-months would  
23 be similar between NAA and Alternative 1A for all months except October, November, and March, in  
24 which degree-months would be 5% to 33% lower under Alternative 1A (Table 11-1A-42).

### 25 **American River**

26 Flows in the American River at the confluence with the Sacramento River were examined for the  
27 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
28 Analysis*). Flows under A1A\_LLT would generally be similar to flows under NAA during January  
29 through April and November through December, greater than flows under NAA during May, June,  
30 and October, and lower than flows under NAA during July through September.

31 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
32 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
33 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results  
34 utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
35 temperature between NAA and Alternative 1A in any month or water year type throughout the  
36 period.

37 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
38 Avenue Bridge was evaluated during May through October (Table 11-1A-57). During May, June, and  
39 October, the percent of months exceeding the threshold under Alternative 1A would similar to or up  
40 to 23% lower (absolute scale) than the percent under NAA. During July through September, the  
41 percent of months exceeding the threshold would mostly be similar between NAA and Alternative  
42 1A with one or two degree categories in which there would be increases of up to 10% on an absolute  
43 scale in percent of months exceeding the threshold under Alternative 1A.

1 **Table 11-1A-57. Differences between Baseline and Alternative 1A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**  
 3 **River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LL1</b>					
May	33 (169%)	26 (175%)	15 (133%)	11 (180%)	4 (75%)
June	33 (52%)	31 (58%)	17 (42%)	14 (44%)	9 (41%)
July	0 (0%)	1 (1%)	31 (49%)	44 (124%)	41 (236%)
August	0 (0%)	2 (3%)	19 (23%)	52 (108%)	67 (216%)
September	15 (17%)	47 (88%)	63 (196%)	68 (423%)	57 (767%)
October	68 (1,375%)	48 (1,950%)	33 (NA)	16 (NA)	9 (NA)
<b>NAA vs. A1A_LL1</b>					
May	-11 (-17%)	-9 (-18%)	-14 (-34%)	-15 (-46%)	-9 (-50%)
June	-1 (-1%)	-7 (-8%)	-23 (-29%)	-21 (-32%)	-19 (-38%)
July	0 (0%)	0 (0%)	-4 (-4%)	9 (12%)	2 (4%)
August	0 (0%)	0 (0%)	0 (0%)	4 (4%)	7 (8%)
September	0 (0%)	2 (3%)	10 (12%)	10 (13%)	4 (6%)
October	-7 (-9%)	-15 (-23%)	-12 (-27%)	-14 (-46%)	-2 (-22%)
NA = could not be calculated because the denominator was 0.					

4

5 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
 6 Avenue Bridge during May through October (Table 11-1A-58). During May, June, and October, total  
 7 degree-months would be similar between NAA and Alternative 1A or up to 16% lower under  
 8 Alternative 1A. During July through September, there would be 5% to 13% increases in total degree-  
 9 months exceeding the threshold.

1 **Table 11-1A-58. Differences between Baseline and Alternative 1A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 65°F in the American River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
May	Wet	19 (317%)	-2 (-7%)
	Above Normal	21 (NA)	-6 (-22%)
	Below Normal	16 (533%)	-7 (-27%)
	Dry	20 (91%)	-14 (-25%)
	Critical	33 (174%)	1 (2%)
	All	108 (216%)	-29 (-16%)
June	Wet	45 (265%)	-23 (-27%)
	Above Normal	18 (75%)	-14 (-25%)
	Below Normal	21 (72%)	-17 (-25%)
	Dry	41 (60%)	1 (1%)
	Critical	44 (88%)	-6 (-6%)
	All	168 (89%)	-60 (-14%)
July	Wet	57 (73%)	8 (6%)
	Above Normal	16 (59%)	10 (30%)
	Below Normal	35 (103%)	14 (25%)
	Dry	77 (124%)	26 (23%)
	Critical	50 (62%)	4 (3%)
	All	234 (83%)	61 (13%)
August	Wet	102 (129%)	-6 (-3%)
	Above Normal	37 (90%)	4 (5%)
	Below Normal	56 (100%)	19 (20%)
	Dry	93 (137%)	12 (8%)
	Critical	69 (87%)	5 (3%)
	All	356 (110%)	33 (5%)
September	Wet	108 (450%)	34 (35%)
	Above Normal	47 (294%)	11 (21%)
	Below Normal	50 (179%)	3 (4%)
	Dry	85 (202%)	-1 (-1%)
	Critical	54 (110%)	1 (1%)
	All	344 (216%)	48 (11%)
October	Wet	47 (4,700%)	-7 (-13%)
	Above Normal	29 (NA)	3 (12%)
	Below Normal	32 (NA)	-7 (-18%)
	Dry	35 (NA)	-2 (-5%)
	Critical	27 (540%)	-3 (-9%)
	All	169 (2,817%)	-17 (-9%)

NA = could not be calculated because the denominator was 0.

4

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
3 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4 *Analysis*). Flows under A1A\_LLT would be similar to flows under NAA throughout the period.

5 Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and  
6 Alternative 1A throughout the year-round period (Appendix 11D, *Sacramento River Water Quality*  
7 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

8 **San Joaquin River**

9 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
10 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT  
11 would be similar to flows under NAA throughout the period.

12 Water temperature modeling was not conducted in the San Joaquin River.

13 **Mokelumne River**

14 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
15 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT  
16 would be similar to flows under NAA throughout the period.

17 Water temperature modeling was not conducted in the Mokelumne River.

18 **NEPA Effects:** Collectively, it is concluded that the effect of Alternative 1A is not adverse because it  
19 does not have the potential to substantially reduce rearing habitat or substantially reduce the  
20 number of fish. Flows reductions under Alternative 1A would cause a moderate reduction in rearing  
21 habitat availability and moderate increase in juvenile stranding risk in the Sacramento River.  
22 However, there would generally be beneficial temperature-related effects of Alternative 1A in the  
23 Feather and American Rivers. There would generally be no effects in the other rivers examined.

24 **CEQA Conclusion:** In general, Alternative 1A would not affect the quantity or quality of steelhead  
25 rearing habitat relative to the Existing Conditions.

26 **Sacramento River**

27 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and  
28 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*  
29 *II Model Results utilized in the Fish Analysis*). Flows during October and between December and July  
30 under A1A\_LLT would generally be similar to or up to 40% greater than those under Existing  
31 Conditions. Flows under A1A\_LLT during August, September and November would generally be  
32 lower by up to 33% than under Existing Conditions.

33 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
34 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
35 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At  
36 both locations, mean monthly water temperatures under Alternative 1A would generally be similar  
37 to those under Existing Conditions, except during August through December, in which there would  
38 be 5% to 7% higher temperatures under Alternative 1A.

1 SacEFT predicts that there would be a 10% decrease in the percentage of years with good rearing  
2 habitat availability, measured as weighted usable area, under A1A\_LLT relative to Existing  
3 Conditions (Table 11-1A-52). SacEFT predicts that there would be a substantial reduction (-56%) in  
4 the number of years with good (lower) juvenile stranding risk under A1A\_LLT relative Existing  
5 Conditions.

### 6 **Clear Creek**

7 Flows in Clear Creek during the year-round rearing period under A1A\_LLT would generally be  
8 similar to or greater than flows under Existing Conditions, except for critical years in February and  
9 August and September, in which flows would be 17% to 37% lower, respectively (Appendix 11C,  
10 *CALSIM II Model Results utilized in the Fish Analysis*).

11 No water temperature modeling was conducted in Clear Creek.

12 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and  
13 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile  
14 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream  
15 flows affecting juvenile rearing habitat are shown in Table 11-1A-56. Results indicate that  
16 Alternative 1A would have no effect on juvenile rearing habitat, based on minimum instream flows,  
17 compared to Existing Conditions with the exception of a 21% increase in the minimum flow in below  
18 normal years, and a 100% decrease in the minimum flow during critical flow years.

19 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-  
20 1A-4). The current Clear Creek management regime uses flows slightly lower than those  
21 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being  
22 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We  
23 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.  
24 No change in effect on steelhead in Clear Creek is anticipated.

### 25 **Feather River**

26 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and  
27 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 1A relative to  
28 Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period  
29 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at  
30 Thermalito Afterbay), flows under A1A\_LLT would be mostly lower (up to 56%) during July through  
31 September and mostly similar to or greater than flows under Existing Conditions from October  
32 through June with few exceptions during which flows would be up to 48% lower under A1A\_LLT.

33 May Oroville storage volume under A1A\_LLT would be lower than Existing Conditions by 7% to 15%  
34 depending on water year type, except in wet years, in which storage would be similar to Existing  
35 Conditions (Table 11-1A-30).

36 Oroville Reservoir storage volume at the end of September would be similar under A1A\_LLT relative  
37 to Existing Conditions during dry and critical water years, but moderately lower (up to 21% lower)  
38 for other water year types (Table 11-1A-27).

39 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
40 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
41 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*

1 *Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water  
2 temperatures under Alternative 1A would be similar to those under Existing Conditions between  
3 April and September, but would be 5% to 10% higher between October and March. In the high-flow  
4 channel, mean monthly water temperatures under Alternative 1A would be similar to those under  
5 Existing Conditions between March through July and in September, but would be 5% to 8% in the  
6 remaining six months.

7 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in  
8 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and  
9 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-  
10 flow channel, the percent of months exceeding the threshold under Alternative 1A would generally  
11 be similar to the percent under Existing Conditions during May, and similar or up to 49% (absolute  
12 scale) higher than the percent under Existing Conditions during June through August (Table 11-1A-  
13 31). At Gridley, the percent of months exceeding the threshold under Alternative 1A would similar  
14 to the percent under Existing Conditions during December through February, but similar to or up to  
15 47% greater (absolute scale) than the percent under Existing Conditions in the remaining 4 months  
16 (Table 11-1A-41).

17 Total degree-months exceeding 56°F were summed by month and water year type in the Feather  
18 River above Thermalito Afterbay (low-flow channel) (May through August) at Gridley during  
19 October through April. In the low-flow channel, total degree-months under Alternative 1A would be  
20 similar to those under Existing Conditions during May and 51% to 159% higher during June through  
21 August (Table 11-1A-32). At Gridley, total degree-months under Alternative 1A would be similar to  
22 those under Existing Conditions during December through and February and 91% to 2075% greater  
23 than those under Existing Conditions in the remaining months of the period (Table 11-1A-42).

#### 24 **American River**

25 Flows in the American River at the confluence with the Sacramento River were examined for the  
26 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
27 Analysis*). Flows under A1A\_LLT would be up to 45% greater than to flows under Existing Conditions  
28 during February, March, and October, similar to flows under Existing Conditions during April and  
29 June, and up to 58% lower than flows under Existing Conditions during the remaining seven months  
30 of the year.

31 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
32 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
33 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results  
34 utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
35 temperature between Existing Conditions and Alternative 1A during April, June and July but higher  
36 mean monthly water temperatures in the other months and most water year types throughout the  
37 period.

38 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
39 Avenue Bridge was evaluated during May through October (Table 11-1A-57). Under A1A\_LLT  
40 compared to Existing Conditions virtually all months in all years exceed the threshold by 15% to  
41 68% (absolute scale) except for July and August for the 1 degree and 2 degree categories.

42 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
43 Avenue Bridge during May through October (Table 11-1A-58). During all months and water year

1 types the total degree-months would be higher between Existing Conditions and Alternative 1A by  
2 59% to 4500%.

### 3 ***Stanislaus River***

4 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
5 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Flows under A1A\_LLT would be similar to flows under Existing Conditions during August,  
7 September, and November and up to 26% lower than flows under Existing Conditions during the  
8 remaining 9 months.

9 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
10 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,  
11 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
12 *Fish Analysis*). Mean monthly water temperatures under Alternatives 1A would be 6% greater than  
13 those under Existing Conditions during January through May, August, September, November, and  
14 December and would be similar to those under Existing Conditions in the remaining 3 months.

### 15 ***San Joaquin River***

16 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
17 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT  
18 would be up to 6% higher than Existing Conditions during January, generally similar to Existing  
19 Conditions during February except for being lower in two water years, lower in most water years  
20 than Existing Conditions during March through October (up to 38% lower), and similar to Existing  
21 Conditions during November and December.

22 Water temperature modeling was not conducted in the San Joaquin River.

### 23 ***Mokelumne River***

24 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
25 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT  
26 would be similar to flows under Existing Conditions during January through March, up to 15%  
27 greater than flows under Existing Conditions during December, and up to 52% lower than flows  
28 under Existing Conditions during the remaining 8 months.

29 Water temperature modeling was not conducted in the Mokelumne River.

### 30 **Summary of CEQA Conclusion**

31 Collectively, the results of the Impact AQUA-95 CEQA analysis indicate that the difference between  
32 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
33 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set  
34 forth above. SacEFT predicts that there would be a small reduction in the number of years with good  
35 rearing habitat availability, and a substantial reduction in the number of years with good juvenile  
36 stranding risk. Flows in the Feather River high-flow channel would be mostly lower during summer  
37 months (July through September) but there would be no difference in flows in the low-flow channel.  
38 Flows would be lower during the majority of months in the American, Stanislaus, and Mokelumne  
39 Rivers. NMFS temperature thresholds would be exceeded more often and at a higher magnitude  
40 under Alternative 1A in the Feather and American Rivers.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
4 the alternative from those of sea level rise, climate change and future water demands using the  
5 model simulation results presented in this chapter. However, the increment of change attributable  
6 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
7 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 1A indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on steelhead rearing habitat. This impact is found to be less than  
20 significant and no mitigation is required.

## 21 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

### 22 **Upstream of the Delta**

23 In general, Alternative 1A would reduce migration conditions for steelhead relative to NAA.

#### 24 ***Sacramento River***

##### 25 *Juveniles*

26 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through  
27 May juvenile steelhead migration period. Flows under A1A\_LLTT would be 9% to 30% lower than  
28 flows under NAA during November depending on water year type and would be up to 33% higher  
29 during October, April, and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
30 Flows under A1A\_LLTT in the remaining four months of the migration period would be similar to  
31 flows under NAA.

32 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
33 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
34 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
35 There would be no differences (<5%) in mean monthly water temperature between NAA and  
36 Alternative 1A in any month or water year type throughout the period.

##### 37 *Adults*

38 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through  
39 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
40 *the Fish Analysis*). Flows under A1A\_LLTT would up to 44% lower than flows under NAA during  
41 September and November depending on water year type and would be up to 33% higher during

1 October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT  
2 in the remaining four months of the migration period would be similar to flows under NAA.

3 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
4 during the September through March steelhead adult upstream migration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 NAA and Alternative 1A in any month or water year type throughout the period.

#### 8 *Kelts*

9 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April  
10 steelhead kelt (post-spawning adult fish) downstream migration period (Appendix 11C, *CALSIM II*  
11 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to flows under  
12 NAA during March and up to 10% greater than flows under NAA during April.

13 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
14 during the March through April steelhead kelt downstream migration period (Appendix 11D,  
15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
17 NAA and Alternative 1A in any month or water year type throughout the period.

#### 18 **Clear Creek**

19 Water temperatures were not modeled in Clear Creek.

#### 20 *Juveniles*

21 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period  
22 under A1A\_LLT would be similar to or greater than flows under NAA throughout the period  
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 24 *Adults*

25 Flows in Clear Creek during the September through March adult steelhead migration period under  
26 A1A\_LLT would generally be similar to flows under NAA except in critical years during June (8%  
27 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 28 *Kelt*

29 Flows in Clear Creek, throughout the March through April steelhead kelt downstream migration  
30 period under A1A\_LLT, would be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results*  
31 *utilized in the Fish Analysis*).

#### 32 **Feather River**

#### 33 *Juveniles*

34 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
35 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
36 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be up to 59% greater than flows under  
37 NAA with few exceptions.

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
2 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 NAA and Alternative 1A in any month or water year type throughout the period.

#### 6 *Adults*

7 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
8 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLTT would generally be similar to or up  
10 to 59% greater than flows under NAA, except during September, in which flows would be up to 69%  
11 lower than flows under NAA.

12 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
13 were evaluated during the September through March steelhead adult upstream migration period  
14 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
15 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
16 temperature between NAA and Alternative 1A in any month or water year type throughout the  
17 period.

#### 18 *Kelt*

19 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
20 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
21 *Results utilized in the Fish Analysis*). Flows under A1A\_LLTT would generally be up to 29% greater  
22 than flows under NAA.

23 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
24 were evaluated during the March through April steelhead kelt downstream migration period  
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
26 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
27 temperature between NAA and Alternative 1A in any month or water year type throughout the  
28 period.

#### 29 ***American River***

##### 30 *Juveniles*

31 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
32 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
33 *utilized in the Fish Analysis*). Flows under A1A\_LLTT would generally be similar to flows under NAA  
34 except during October and May, in which flows would be up to 42% greater than flows under NAA.

35 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
36 River were evaluated during the October through May juvenile steelhead migration period  
37 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
38 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
39 temperature between NAA and Alternative 1A in any month or water year type throughout the  
40 period.

1       **Adults**

2       Flows in the American River at the confluence with the Sacramento River were evaluated during the  
3       September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
4       *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be up to 50% lower than  
5       flows under NAA during September, up to 42% greater than flows under NAA during October, and  
6       generally similar to flows under NAA in the remaining five months of the period.

7       Mean monthly water temperatures in the American River at the confluence with the Sacramento  
8       River were evaluated during the September through March steelhead adult upstream migration  
9       period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
10       *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
11       temperature between NAA and Alternative 1A in any month or water year type throughout the  
12       period.

13       **Kelt**

14       Flows in the American River at the confluence with the Sacramento River were evaluated for the  
15       March and April kelt migration period. Flows under A1A\_LLT would generally be similar to or  
16       greater than flows under NAA except in dry and critical years during March (9% lower in both water  
17       year types) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18       Mean monthly water temperatures in the American River at the confluence with the Sacramento  
19       River were evaluated during the March through April steelhead kelt downstream migration period  
20       (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
21       *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
22       temperature between NAA and Alternative 1A in any month or water year type throughout the  
23       period.

24       **Stanislaus River**

25       Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 1A are not  
26       different from flows under NAA for any month. Therefore, there would be no effect of Alternative 1A  
27       on juvenile, adult, or kelt migration in the Stanislaus River.

28       Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San  
29       Joaquin River for Alternative 1A are not different from flows under NAA for any month. Therefore,  
30       there would be no effect of Alternative 1A on juvenile, adult, or kelt migration in the Stanislaus  
31       River.

32       **San Joaquin River**

33       Flows in the San Joaquin River at Vernalis for Alternative 1A are not different from flows under NAA  
34       for any month. Therefore, there would be no effect of Alternative 1A on juvenile, adult, or kelt  
35       migration in the San Joaquin River.

36       Water temperature modeling was not conducted in the San Joaquin River.

1 ***Mokelumne River***

2 Flows in the Mokelumne River at the Delta for Alternative 1A are not different from flows under  
3 NAA for any month. Therefore, there would be no effect of Alternative 1A on juvenile, adult, or kelt  
4 migration in the Mokelumne River.

5 Water temperature modeling was not conducted in the Mokelumne River.

6 **Through-Delta**

7 The approach for steelhead impact assessment is similar to that for Chinook salmon (see Impact  
8 AQUA-42 for Alternative 1A). Although steelhead have a similar life history to salmon, there are a  
9 few marked differences: juvenile steelhead spend from 1 to 3 years rearing in upstream habitats and  
10 migrate downstream as larger juveniles (usually >200 mm) compared to Chinook salmon, and  
11 adults do not necessarily die after spawning but can return to the ocean to grow and reproduce  
12 again. Adults can return one to three times before dying. The post-spawned adult life stage is termed  
13 a kelt and is unique to steelhead.

14 Overall, juvenile steelhead can be found in the Delta during most months of the year, but the  
15 outmigration spans from October through May with a peak outmigration period in February and  
16 March. Adult steelhead can also be found in the Delta almost year round with the adult upstream  
17 migration from September through March with a peak December through February. The kelt  
18 outmigration follows on the upstream migration and spawning and therefore is January through  
19 April. Olfactory cues for upstream migrating adults were assessed using fingerprinting analysis to  
20 estimate the percentage of source water from the Sacramento and San Joaquin Rivers.

21 ***Sacramento River***

22 *Juveniles*

23 Flows in the Sacramento River below the north Delta intakes during the juvenile steelhead  
24 migration period (October through May) would increase in October (15% increase), decrease 10-  
25 20% December to May, and decrease up to 31% in November. Juvenile steelhead and juvenile  
26 winter-run Chinook salmon migrate downstream during the same months and would be exposed to  
27 similar conditions. As discussed above in Impact AQUA-42, the five north Delta intakes structures of  
28 Alternative 1A would increase potential predation loss of migrating juvenile salmonids and would  
29 displace 22 acres of aquatic habitat. Losses of juvenile winter-run Chinook salmon were estimated  
30 ranging from 2% up to 18.5% of annual production (Impact AQUA\_42). However, juvenile steelhead  
31 would be less vulnerable than winter-run Chinook salmon to predation associated with the intake  
32 facilities because of their greater size and strong swimming ability.

33 *Adults*

34 For Sacramento River steelhead, straying rates of adult hatchery-origin Chinook salmon that were  
35 released upstream of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-  
36 origin steelhead apparently have not been examined in detail, for this analysis of effects, it was  
37 assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to  
38 straying have low importance under Existing Conditions for adult Sacramento River region  
39 steelhead.

1 As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin  
2 water at Collinsville was always slightly lower under Alternative 1A than for NAA during the  
3 September-March steelhead upstream migration period. Based on the proportion of Sacramento  
4 River flows, olfactory cues would be similar (<10% difference) to NAA for nearly all months of the  
5 year. The proportion of flows would decrease 12% in September.

## 6 ***San Joaquin River***

### 7 *Adults*

8 Little information apparently currently exists as to the importance of Plan Area flows on the straying  
9 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon  
10 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of  
11 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including  
12 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region  
13 steelhead adults as well.

14 The percentage of water at Collinsville that originated from the San Joaquin River during the fall-run  
15 migration period (September to December) is small, typically 0.1% to less than 3% under NAA.  
16 Alternative 1A operations conditions would incrementally increase olfactory cues associated with  
17 the San Joaquin River, which would benefit adult steelhead migrating to the San Joaquin River.

18 ***NEPA Effects:*** Overall, the results indicate that the effect of Alternative 1A is adverse due to the  
19 cumulative effects associated with five north Delta intake facilities, including mortality related to  
20 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to  
21 reduced flows downstream of the intakes) associated with the five NDD intakes.

22 Upstream of the Delta, flow and water temperature conditions under Alternative 1A would generally  
23 be similar to or better for steelhead than those under Existing Conditions in all rivers examined.

24 Adult attraction flows in the Delta under Alternative 1A would be lower than those under NAA, but  
25 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

26 Near-field effects of Alternative 1A NDD on steelhead from the Sacramento River and tributaries  
27 related to impingement and predation associated with five new intakes could result in substantial  
28 effects on juvenile migrating steelhead, although there is high uncertainty regarding the potential  
29 effects. Estimates within the effects analysis range from very low levels of effects (~2% mortality) to  
30 very significant effects (~ 19% mortality above current baseline levels). CM15 would be  
31 implemented with the intent of providing localized and temporary reductions in predation pressure  
32 at the NDD. Additionally, several pre-construction surveys to better understand how to minimize  
33 losses associated with the five new intake structures will be implemented as part of the final NDD  
34 screen design effort. Alternative 1A also includes an Adaptive Management Program and Real-Time  
35 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
36 adequate migration conditions for steelhead. However, at this time, due to the absence of  
37 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality  
38 expected from near-field effects at the NDD remains highly uncertain.

39 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
40 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
41 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 1A  
42 predict improvements in smolt condition and survival associated with increased access to the Yolo

1 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
2 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
3 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

4 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
5 all of these elements of BDCP operations and conservation measures to predict smolt migration  
6 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
7 migration survival under Alternative 1A would be similar to survival rates estimated for NAA.  
8 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
9 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
10 future. These efforts are expected to improve our understanding of the relationships and  
11 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
12 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
13 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
14 1A on steelhead through-Delta survival remains uncertain.

15 Therefore, primarily as a result of unacceptable levels of uncertainty regarding the cumulative  
16 impacts of near-field and far-field effects associated with the presence and operation of the five  
17 intakes on steelhead, this effect is adverse.

18 While the implementation of the conservation and mitigation measures described below would  
19 address these impacts, these measures are not anticipated to reduce the impact to a level considered  
20 not adverse.

21 **CEQA Conclusion:** In general, Alternative 1A would reduce migration conditions for steelhead  
22 relative to the Existing Conditions.

## 23 **Upstream of the Delta**

### 24 ***Sacramento River***

#### 25 *Juveniles*

26 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through  
27 May juvenile steelhead migration period. Flows under A1A\_LLT would be up to 13% lower than  
28 flows under Existing Conditions during November, but would generally be greater than or similar to  
29 flows under Existing Conditions in the remaining seven months of the juvenile migration period  
30 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
32 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento  
33 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
34 There would be no differences (<5%) in mean monthly water temperature between Existing  
35 Conditions and Alternative 1A in all months but October, in which temperatures under Alternative  
36 1A would be 5% greater than those under Existing Conditions.

#### 37 *Adults*

38 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through  
39 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in  
40 the Fish Analysis*). Flows under A1A\_LLT would be up to 24% lower than flows under Existing

1 Conditions during September and November but would be similar to or greater than flows under  
2 Existing Conditions during the remaining five months of the migration period.

3 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
4 during the September through March steelhead adult upstream migration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 Existing Conditions and Alternative 1A in all months except September and October, in which  
8 temperatures under Alternative 1A would be 5% to 7% greater than those under Existing  
9 Conditions.

#### 10 *Kelts*

11 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April  
12 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
13 *Fish Analysis*). Flows under A1A\_LL1T would be similar to or greater than those under Existing  
14 Conditions throughout the period.

15 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
16 during the March through April steelhead kelt downstream migration period (Appendix 11D,  
17 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
18 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
19 Existing Conditions and Alternative 1A in any month or water year type throughout the period.

#### 20 **Clear Creek**

21 Water temperatures were not modeled in Clear Creek.

#### 22 *Juveniles*

23 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period  
24 under A1A\_LL1T would generally be similar to or greater than flows under Existing Conditions  
25 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 26 *Adults*

27 Flows in Clear Creek during the September through March adult steelhead migration period under  
28 A1A\_LL1T would generally be similar to flows under Existing Conditions except in critical years  
29 during September (37% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 30 *Kelt*

31 Flows in Clear Creek during the March through April steelhead kelt downstream migration period  
32 under A1A\_LL1T would be similar to or greater than flows under Existing Conditions (Appendix 11C,  
33 *CALSIM II Model Results utilized in the Fish Analysis*).

#### 34 **Feather River**

#### 35 *Juveniles*

36 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
37 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*

1 *utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to or up to 37% greater than  
2 flows under Existing Conditions throughout the period.

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
4 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 Existing Conditions and Alternative 1A in all months except November and December, in which  
8 temperatures under Alternative 1A would be 5% greater than temperatures under Existing  
9 Conditions.

#### 10 *Adults*

11 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
12 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*  
13 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be up to 27% lower than  
14 flows under Existing Conditions during September and similar to or up to 37% greater than flows  
15 under Existing Conditions in the remaining six months of the period.

16 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17 were evaluated during the September through March steelhead adult upstream migration period  
18 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
19 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
20 temperature between Existing Conditions and Alternative 1A in all months except November and  
21 December, in which temperatures under Alternative 1A would be 5% greater than temperatures  
22 under Existing Conditions.

#### 23 *Kelt*

24 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
25 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
26 *Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be up to 29% greater than flows  
27 under Existing Conditions.

28 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
29 were evaluated during the March through April steelhead kelt downstream migration period  
30 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
31 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
32 temperature between Existing Conditions and Alternative 1A in any month or water year type  
33 throughout the period.

#### 34 **American River**

##### 35 *Juveniles*

36 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
37 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
38 *utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be up to 45% greater than flows  
39 under Existing Conditions during October, February, and March. Flows under A1A\_LLT would  
40 generally be up to 38% lower than flows under Existing Conditions during November through

1 January and May. Flows under A1A\_LLT would be similar to those under Existing Conditions during  
2 April.

3 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
4 River were evaluated during the October through May juvenile steelhead migration period  
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
6 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would be 5%  
7 to 11% higher than those under Existing Conditions in all months during the period except  
8 December and April, in which there would be no difference in water temperatures between Existing  
9 Conditions and Alternative 1A.

#### 10 *Adults*

11 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
12 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
13 *Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would generally be up to 45%  
14 greater than flows under Existing Conditions during October, February, and March. Flows under  
15 A1A\_LLT would generally be up to 58% lower than flows under Existing Conditions during  
16 September and November through January.

17 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
18 River were evaluated during the September through March steelhead adult upstream migration  
19 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
20 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
21 be 5% to 11% higher than those under Existing Conditions in all months during the period except  
22 December, in which there would be no difference in water temperatures between Existing  
23 Conditions and Alternative 1A.

#### 24 *Kelt*

25 Flows in the American River at the confluence with the Sacramento River were evaluated for the  
26 March and April kelt migration period. Flows under A1A\_LLT would generally be up to 14% greater  
27 than flows under Existing Conditions during March and generally similar to flows under Existing  
28 Conditions during April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
30 River were evaluated during the September through March steelhead adult upstream migration  
31 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
32 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
33 be 5% higher than those under Existing Conditions in March but temperatures would be similar  
34 between Existing Conditions and Alternative 1A during April.

#### 35 ***Stanislaus River***

##### 36 *Juveniles*

37 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
38 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*  
39 *Model Results utilized in the Fish Analysis*). Mean monthly flows under A1A\_LLT would be 6% to 16%  
40 lower than flows under Existing Conditions depending on month.

1 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
2 River were evaluated during the October through May steelhead juvenile downstream migration  
3 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
4 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
5 be 5% to 6% higher than those under existing in all months during the period except October, in  
6 which temperature would be similar between Existing Conditions and Alternative 1A.

#### 7 *Adults*

8 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
9 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
10 *Model Results utilized in the Fish Analysis*). Mean monthly flows under A1A\_LL1 would be 6% to 16%  
11 lower than flows under Existing Conditions depending on month.

12 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
13 River were evaluated during the September through March steelhead adult upstream migration  
14 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
15 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would  
16 be 6% higher than those under Existing Conditions in all months during the period except October,  
17 in which temperature would be similar between Existing Conditions and Alternative 1A

#### 18 *Kelt*

19 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
20 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
21 *Results utilized in the Fish Analysis*). Mean monthly flows under A1A\_LL1 would be 8% to 11% lower  
22 than flows under Existing Conditions during March and April, respectively.

23 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
24 River were evaluated during the March and April steelhead kelt downstream migration period  
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
26 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would be 6%  
27 higher than those under Existing Conditions during March and April.

#### 28 ***San Joaquin River***

29 Water temperature modeling was not conducted in the San Joaquin River.

#### 30 *Juveniles*

31 Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead  
32 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
33 *Analysis*). Mean monthly flows under Alternative 1A would be up to 8% lower than Existing  
34 Conditions in most water years during October, similar to Existing Conditions in November and  
35 December (each month with one water year greater than 5% lower), up to 6% higher than Existing  
36 Conditions during January, generally similar to Existing Conditions during February except for being  
37 lower in two water years, and up to 16% lower in most water years than Existing Conditions during  
38 March through May under Alternative 1A.

1       **Adults**

2       Flows in the San Joaquin River at Vernalis were evaluated for the September through March  
3       steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
4       *Fish Analysis*). Mean monthly flows under Alternative 1A would be up to 11% lower than Existing  
5       Conditions in most water years during September and October, similar to Existing Conditions in  
6       November and December (each month with one water year greater than 5% lower), up to 6% higher  
7       than Existing Conditions during January, generally similar to Existing Conditions during February  
8       except for being lower in two water years, and up to 16% lower in most water years than Existing  
9       Conditions during March.

10       **Kelt**

11       Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt  
12       downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
13       Mean monthly flows under Alternative 1A would be lower than flows under Existing Conditions in  
14       most water years (up to 16% lower) during both months.

15       **Mokelumne River**

16       Water temperature modeling was not conducted in the Mokelumne River.

17       **Juveniles**

18       Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead  
19       juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
20       *Analysis*). Mean monthly flows under Alternative 1A would be flows under Existing Conditions  
21       during October and March, 8% to 12% lower than flows under Existing Conditions during  
22       November, April, and May, and 12% to 14% higher than flows under Existing Conditions during  
23       December through February.

24       **Adults**

25       Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead  
26       adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
27       *Analysis*). Mean monthly flows under Alternative 1A would be flows under Existing Conditions  
28       during October and March, 9% to 27% lower than flows under Existing Conditions during  
29       September and November, and 12% to 14% higher than flows under Existing Conditions during  
30       December through February.

31       **Kelt**

32       Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt  
33       downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
34       Mean monthly flows under Alternative 1A would be similar to flows under Existing Conditions  
35       during March and 8% lower during April.

1 **Through-Delta**

2 ***Sacramento River***

3 *Juveniles*

4 Flows in the Sacramento River below the north Delta intakes during the juvenile steelhead  
5 migration period (October through May) would increase in October (15% increase), decrease 10-  
6 20% December to May, and decrease up to 31% in November. Juvenile steelhead and juvenile  
7 winter-run Chinook salmon migrate downstream during the same months and are exposed to  
8 similar conditions. As discussed above in Impact AQUA-42, the five north Delta intakes structures of  
9 Alternative 1A would increase potential predation loss of migrating juvenile winter-run Chinook  
10 salmon and would displace 22 acres of aquatic habitat. However, because of their greater size and  
11 strong swimming ability, juvenile steelhead would be less vulnerable than winter-run Chinook  
12 salmon to predation associated with the intake facilities.

13 *Adults*

14 For Sacramento River steelhead, straying rates of adult hatchery-origin Chinook salmon that were  
15 released upstream of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-  
16 origin steelhead apparently have not been examined in detail, for this analysis of effects, it was  
17 assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to  
18 straying have low importance under Existing Conditions for adult Sacramento River region  
19 steelhead.

20 As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin  
21 water at Collinsville was always slightly lower under Alternative 1A than for Existing Conditions  
22 during the September-March steelhead upstream migration period. Based on the proportion of  
23 Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions  
24 for nearly all months of the year. The proportion of flows would decrease 11% in March.

25 ***San Joaquin River***

26 *Adults*

27 Little information apparently currently exists as to the importance of Plan Area flows on the straying  
28 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon  
29 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of  
30 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including  
31 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region  
32 steelhead adults as well.

33 The percentage of water at Collinsville that originated from the San Joaquin River is small (no more  
34 than 3% under Existing Conditions) during the steelhead migration period (September to March).  
35 Alternative 1A operations conditions would incrementally increase olfactory cues associated with  
36 the San Joaquin River, which would benefit adult steelhead migrating to the San Joaquin River.

37 **Summary of CEQA Conclusion**

38 Overall, the results indicate that the effect of Alternative 1A is adverse because it has the potential to  
39 substantially decrease steelhead migration habitat conditions upstream of the Delta. In addition, this  
40 alternative is adverse due to the cumulative effects associated with five north Delta intake facilities,

1 including mortality related to near-field effects (e.g. impingement and predation) and far-field  
2 effects (reduced survival due to reduced flows downstream of the intakes) associated with the five  
3 NDD intakes.

4 Upstream of the Delta, flows would generally be lower and temperatures would generally be higher  
5 during substantial portions of the juvenile and adult migration periods in the American River,  
6 juvenile, adult, and kelt migration periods in the Stanislaus River, and the kelt period in the San  
7 Joaquin River.

8 In the Delta, the impact on emigrating juveniles would be significant due to the impacts associated  
9 with predation and habitat loss from the five intakes under this alternative (similar to the previous  
10 description under Impact AQUA-42). Implementation of CM6 and CM15 would address these  
11 impacts, but are not anticipated to reduce them to a level considered less than significant. Although  
12 implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which  
13 would be lost, it would not necessarily be located near the intakes and therefore would not fully  
14 compensate for the lost habitat. Additionally, implementation of this measure would not fully  
15 address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has  
16 substantial uncertainties associated with its effectiveness such that it is considered to have no  
17 demonstrable effect. Conservation measures that address habitat and predation losses, therefore,  
18 would potentially minimize impacts to some extent but not to a less than significant level.  
19 Consequently, as a result of these changes in migration conditions, this impact is significant and  
20 unavoidable.

21 Applicable conservation measures are briefly described below and full descriptions are found in  
22 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
23 Reduction of Predatory Fishes (Predator Control) (CM15).

24 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
25 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
26 habitats on the waterside side of levees along channels that provide rearing and outmigration  
27 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
28 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
29 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
30 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
31 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
32 margin enhancement would be performed only along channels that provide rearing and  
33 outmigration habitat for juvenile salmonids. These include channels that are protected by  
34 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
35 among several others.

36 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
37 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
38 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
39 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
40 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
41 Therefore, this conservation measure is not intended to entirely remove predators at any  
42 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
43 conservation measure would also not remove piscivorous birds. Because of uncertainties  
44 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
45 projects and research actions coupled with an adaptive management and monitoring program to

1 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
2 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
3 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

4 This impact is a result of the specific reservoir operations and resulting flows associated with this  
5 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
6 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
7 change the alternative, thereby making it a different alternative than that which has been modeled  
8 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
9 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
10 severity of impact though not necessarily to a less-than-significant level.

11 **Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional**  
12 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**  
13 **Reduce Impacts to Migration Conditions**

14 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
15 significant and unavoidable adverse effects on migration habitat, this conclusion was based on  
16 the best available scientific information at the time and may prove to have been over- or  
17 understated. Upon the commencement of operations of CM1 and continuing through the life of  
18 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
19 whether such effects would be as extensive as concluded at the time of preparation of this  
20 document and to determine any potentially feasible means of reducing the severity of such  
21 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
22 consistent with the operational framework for Alternative 1A.

23 The development and implementation of any mitigation actions shall be focused on those  
24 incremental effects attributable to implementation of Alternative 1A operations only.  
25 Development of mitigation actions for the incremental impact on migration habitat attributable  
26 to climate change/sea level rise are not required because these changed conditions would occur  
27 with or without implementation of Alternative 1A.

28 **Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts**  
29 **on Steelhead Migration Conditions Following Initial Operations of CM1**

30 Following commencement of initial operations of CM1 and continuing through the life of the  
31 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
32 modified operations could reduce impacts to migration habitat under Alternative 1A. The  
33 analysis required under this measure may be conducted as a part of the Adaptive Management  
34 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

35 **Mitigation Measure AQUA-96c: Consult with USFWS, and CDFW to Identify and Implement**  
36 **Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions**  
37 **Consistent with CM1**

38 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead  
39 habitat, the BDCP proponents will consult with FWS and the Department of Fish and Wildlife to  
40 identify and implement any feasible operational means to minimize effects on migration habitat.  
41 Any such action will be developed in conjunction with the ongoing monitoring and evaluation of  
42 habitat conditions required by Mitigation Measure AQUA-96a.

1 If feasible means are identified to reduce impacts on migration habitat consistent with the  
2 overall operational framework of Alternative 1A without causing new significant adverse  
3 impacts on other covered species, such means shall be implemented. If sufficient operational  
4 flexibility to reduce effects on steelhead habitat is not feasible under Alternative 1A operations,  
5 achieving further impact reduction pursuant to this mitigation measure would not be feasible  
6 under this Alternative, and the impact on steelhead would remain significant and unavoidable.

## 7 **Restoration Measures (CM2, CM4–CM7, and CM10)**

### 8 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

9 Restoration activities are described above under delta smelt (Impact AQUA-7). Potential effects on  
10 steelhead from restoration activities would be similar to those discussed above for winter-run  
11 Chinook salmon (see Impact AQUA-43). However, juvenile steelhead migrants are typically older  
12 and larger than Chinook salmon migrants, making them less susceptible to effects from restoration  
13 construction activities. As larger migrants, steelhead pass through the river more quickly, resulting  
14 in lower risks of exposure to increased turbidity, methylmercury, accidental spills, disturbed  
15 contaminated sediments or predation. Because these restoration activities also would be of  
16 relatively short duration, the effects would be temporary; in addition, the activities would occur in  
17 isolated areas. Implementation of environmental commitments described under Impact AQUA-1 for  
18 delta smelt and in Appendix 3B, *Environmental Commitments* would also minimize or eliminate  
19 effects on steelhead. These environmental commitments include *Environmental Training*;  
20 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
21 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; and *Disposal of Spoils,*  
22 *Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans are provided under  
23 Impact AQUA-1 for delta smelt.

24 **NEPA Effects:** With implementation of the environmental commitments, as well as *CM12*  
25 *Methylmercury Management*, the overall effects of habitat restoration are expected to be beneficial  
26 to steelhead by providing additional or improved habitat.

27 **CEQA Conclusion:** Steelhead are expected to occur in the restoration construction areas for limited  
28 periods of time as they migrate to and from the ocean, minimizing the potential for effects from  
29 restoration construction. In addition to in-water work window restrictions, the limited frequency,  
30 duration, and spatial extent of restoration construction activities would also minimize potential  
31 effects on steelhead. For these reasons, and implementation of the commitments identified above  
32 and described in detail under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
33 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
34 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
35 *Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material)*, along  
36 with *CM12 Methylmercury Management* would reduce the frequency, duration and extent of any  
37 impacts. Therefore, this impact is considered less than significant for steelhead because it would not  
38 substantially reduce habitat, restrict its range or interfere with its movement. Consequently, no  
39 mitigation would be required.

### 40 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

41 As described above for delta smelt and winter-run Chinook salmon, habitat restoration actions could  
42 result in the disturbance or mobilization of upland and aquatic contaminants which could affect

1 steelhead. As previously mentioned, a complete analysis can be found in the *BDCP Effects Analysis –*  
2 *Appendix D, Contaminants (hereby incorporated by reference)*. Potential impacts on steelhead from  
3 effects of methylmercury, selenium, copper, ammonia, and pesticides associated with habitat  
4 restoration activities would be similar to those discussed for delta smelt (see Impact AQUA-8).

5 Steelhead migrate through the plan area relatively quickly, rather than rear or grow there, so the  
6 impacts from contaminants are likely to be lower than for delta smelt. The Yolo Bypass is an area  
7 expected to be among the highest for potential methylmercury production. Future methylmercury  
8 exposure levels in restored habitats that are similar to current levels may not affect the species'  
9 viability, though they may be of concern for passing mercury up the food web to birds and humans.  
10 As described in *BDCP Effects Analysis – Appendix D, Contaminants, Section 5D.4.1 Mercury (hereby*  
11 *incorporated by reference)*, the amounts of methylmercury mobilized and resultant effects on  
12 covered fish species are not currently quantifiable.

13 **NEPA Effects:** It is anticipated that any potential effects of methylmercury on steelhead will be  
14 addressed through implementation of CM12. CM12 is intended to minimize methylmercury  
15 exposure associated with restoration measures for steelhead. Additional analysis and tools may be  
16 developed to further reduce methylmercury exposure as the habitat restoration conservation  
17 measures are refined and analyzed in site-specific documents. The site-specific analysis is the  
18 appropriate place to assess the potential for risk of methylmercury exposure for steelhead once site  
19 specific sampling and other information can be developed. Overall, the effects of contaminants  
20 associated with restoration measures would not be adverse for steelhead with respect to selenium,  
21 copper, ammonia and pesticides. The effects of methylmercury on steelhead are uncertain.

22 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
23 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
24 However, any such releases would be sporadic, short-term and localized, and would be unlikely to  
25 result in measurable increases in the bioaccumulation in steelhead. In addition, implementation of  
26 *CM12 Methylmercury Management* would help to minimize the increased mobilization of  
27 methylmercury at restoration areas. Therefore, the impact of contaminants is considered less than  
28 significant because it would not substantially effect steelhead either directly or through habitat  
29 modifications and, with restoration, would be beneficial in the long-term. Consequently no  
30 mitigation would be required.

### 31 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

32 The expected effects of restored habitat conditions on steelhead would be similar to those discussed  
33 for Chinook salmon under Impact AQUA-45.

### 34 **CM2 Yolo Bypass Fisheries Enhancement**

35 As discussed under Impact AQUA-9 for delta smelt, Yolo Bypass fisheries enhancement  
36 modifications are designed to increase the frequency, duration and magnitude of seasonal floodplain  
37 inundation in the Yolo Bypass. These actions may improve passage and habitat for steelhead. These  
38 modifications, which include fish passage improvements and flow management, would reduce  
39 migratory delays and loss of adult steelhead at Fremont Weir and other structures. They would also  
40 enhance rearing habitat for Sacramento River basin steelhead.

1 **CM4 Tidal Natural Communities Restoration**

2 The potential effects of *CM4 Tidal Natural Communities Restoration* activities on steelhead, would be  
3 similar to those discussed under Impact AQUA-45 for Chinook salmon, although juvenile steelhead  
4 spend less time in the Plan Area. This may explain why they are not as severely affected by the  
5 decline in existing habitat quality. However, Habitat Suitability Analysis indicates that tidal wetland  
6 restoration provides substantial increases in available habitat suitable for juvenile foraging  
7 steelhead as compared to Existing Conditions. Increases in HUs for juvenile salmon are  
8 approximately 5,000 HUs each in the Cache Slough and Suisun Marsh ROAs, 2,000 HUs in the West  
9 Delta ROA, and negligible in the South Delta and Cosumnes-Mokelumne ROAs.

10 **CM5 Seasonally Inundated Floodplain Restoration**

11 The potential effects of *CM5 Seasonally Inundated Floodplain Restoration* on steelhead, would be  
12 similar to those discussed for Chinook salmon under Impact AQUA-45.

13 **CM6 Channel Margin Enhancement**

14 The potential effects of *CM6 Channel Margin Enhancement* on steelhead, would be similar to those  
15 discussed for Chinook salmon under Impact AQUA-45.

16 **CM7 Riparian Natural Community Restoration**

17 The potential effects of *CM7 Riparian Natural Community Restoration* on steelhead, would be similar  
18 to those discussed for Chinook salmon under Impact AQUA-45.

19 **CM10 Nontidal Marsh Restoration**

20 The potential effects of *CM10 Nontidal Marsh Restoration* on steelhead, would be similar to those  
21 discussed for Chinook salmon under Impact AQUA-45.

22 **NEPA Effects:** The effects of floodplain, tidal, channel margin and riparian habitat restoration  
23 activities on Central Valley steelhead are expected to be similar to those discussed for Chinook  
24 salmon (see Impact AQUA-45). In general, these effects are expected to be beneficial for steelhead,  
25 providing increased amounts and quality of available habitat, increasing habitat diversity, increasing  
26 overall productivity and reducing predation. However, steelhead are assumed and/or known to  
27 occur within the Plan Area for relatively short periods of time as both juveniles and adults. As noted  
28 for other salmonids, the benefits of the restoration in the Plan Area include a substantial increase in  
29 tidal, floodplain, channel margin, and riparian habitat, which is anticipated to provide improved  
30 habitat for occupancy and appreciably greater food production for juvenile steelhead; however,  
31 because most juvenile steelhead are typically migrants passing quite quickly through the Plan Area,  
32 the effect of food benefits and habitat change would be limited for rearing.

33 Despite the improvements in habitat and habitat functions in the Delta from floodplain, tidal,  
34 channel margin and riparian habitat restoration activities, habitat quality is expected to decline in  
35 the LLT primarily because of climate change. However, the overall effect of restoration activities is  
36 expected to remain beneficial for steelhead.

37 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
38 management plan would be needed to determine an operational protocol that optimizes benefits  
39 both locally and in adjacent habitats.

1 **CEQA Conclusion:** As with Chinook salmon, the overall effects of floodplain, tidal, channel margin  
2 and riparian habitat restoration activities are expected to be beneficial for Central Valley steelhead,  
3 by providing increased amounts and quality of available habitat, increasing habitat diversity,  
4 increasing overall productivity and reducing predation (see Impact AQUA-45). However, steelhead  
5 are assumed and/or known to occur within the Plan Area for relatively short periods of time as both  
6 juveniles and adults. As noted for other salmonids, the benefits of the restoration in the Plan Area  
7 include a substantial increase in tidal, floodplain, channel margin, and riparian habitat, which is  
8 anticipated to provide improved habitat for occupancy and appreciably greater food production for  
9 juvenile steelhead; however, because most juvenile steelhead are typically migrants passing quite  
10 quickly through the Plan Area, the effect of food benefits and habitat change would be limited for  
11 rearing. Despite the improvements in habitat and habitat functions in the Delta from these  
12 restoration activities, habitat quality is expected to decline in the LLT, primarily because of climate  
13 change. However, the overall impact of restoration activities is expected to remain beneficial for  
14 steelhead because they increase habitat. Consequently, no mitigation would be required.

#### 15 **Other Conservation Measures (CM12–CM19 and CM21)**

##### 16 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

17 Refer to Impact AQUA-10 under delta smelt for a discussion of the potential effects of  
18 methylmercury management on steelhead.

##### 19 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

20 A general analysis of the effects of aquatic vegetation management on covered fish species is  
21 described under the effects for delta smelt (see Impact AQUA-11). Potential impacts on steelhead  
22 from IAV control during operations also are similar to those described for Chinook salmon (Impact  
23 AQUA-47).

24 The control of SAV is expected to reduce predation mortality for steelhead, as predation on juvenile  
25 salmonids in the migration corridor can be significant; for example, it is well-documented that  
26 juvenile Chinook experience predation by largemouth bass lurking in SAV. Removing SAV is  
27 expected to reduce the population of nonnative predatory fish. IAV control is also expected to  
28 increase rearing habitat for steelhead and result in an increase in available food resources.

29 **NEPA Effects:** The overall effect of IAV removal and control is expected to be beneficial to steelhead.

30 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to steelhead during  
31 operations through chemical and mechanical treatment and should reduce predation mortality, and  
32 increase food availability and increase the amount of suitable rearing habitat for juvenile steelhead.  
33 This impact is expected to be beneficial because it increases habitat. Consequently, no mitigation  
34 would be required.

##### 35 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

36 **NEPA Effects:** As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very  
37 similar to Existing Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP  
38 export service areas (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14*  
39 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would increase the dissolved

1 oxygen levels and increase the ability of steelhead to migrate through the area during both upstream  
2 migration and downstream outmigration. The effect would be beneficial.

3 **CEQA Conclusion:** *CM14 Stockton Deepwater Ship Channel Dissolved Oxygen Levels* would increase  
4 dissolved oxygen levels and increase the ability of steelhead to migrate through the area during both  
5 upstream migration and downstream outmigration. This impact would be beneficial because it  
6 would improve habitat conditions. Consequently, no mitigation would be required.

### 7 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

8 **NEPA Effects:** To the extent that localized predator control efforts of *CM15 Localized Reduction of*  
9 *Predatory Fish* reduce the local abundance of fish predators in the Delta occupied by juvenile  
10 steelhead (predation on adult steelhead is minimal), it is possible, but not assured that there would  
11 be some reduction in losses to predation (see Impact AQUA-13). Due to the uncertainties noted  
12 above, there would be no demonstrable effect of this conservation measure on steelhead.

13 **CEQA Conclusion:** Due to the uncertainties associated with this CM, there would be no demonstrable  
14 effect on steelhead. Consequently, no mitigation would be required.

### 15 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

16 **NEPA Effects:** A general analysis of effects of NPBs on covered fish species is described under the  
17 effects for delta smelt (Impact AQUA-14). Potential impacts on steelhead from implementation of  
18 NPBs are similar to those for Chinook salmon (Impact AQUA-50). NPBs, consistent with their  
19 intended purpose, would reduce entrainment for several types of covered fish species, including  
20 juvenile steelhead. Effects are considered not adverse and may be slightly beneficial.

21 **CEQA Conclusion:** NPBs are designed to guide juvenile salmonid fish away from migration routes  
22 with low survival and high predation risk, such as the head of Old River and Georgiana Slough. The  
23 Delta Passage Model incorporates studies of tagged juvenile salmonids to estimate mortality  
24 presumably by predation losses as described in *BDCP Effects Analysis – Appendix C, Flow, Passage,*  
25 *Salinity, and Turbidity, Section C.4.3.2.2 Juvenile Chinook Salmon through-Delta Survival (Delta*  
26 *Passage Model), hereby incorporated by reference). Studies have shown higher survival rates in both*  
27 *the Sacramento River (Perry et al. 2010) and the San Joaquin River (Brandes and McLain 2001)*  
28 *indicating that effective NPBs may reduce predation losses of outmigrating smolts. On the other*  
29 *hand at the NPB at the head of Old River high predation rates were observed (Bowen et al. 2010).*  
30 *Overall, however, the effects of CM16 Effects on Nonphysical Fish Barriers on Steelhead are*  
31 *expected to be less than significant to slightly beneficial because they would reduce steelhead*  
32 *entrainment which would potentially increase their numbers. Consequently, no mitigation would be*  
33 *is required.*

### 34 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

35 **NEPA Effects:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley  
36 steelhead, green sturgeon and white sturgeon and are expected to have positive effects on these  
37 species. The effects on steelhead would be beneficial, by reducing the loss of potential spawners.

38 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
39 Valley steelhead, green sturgeon and white sturgeon and are expected to have positive effects on  
40 these species. The effects on steelhead would be beneficial because it would reduce the number of

1 illegally harvested fish, and potentially increasing the number of successful spawners. Consequently,  
2 no mitigation would be required.

### 3 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

4 **NEPA Effects:** *CM18 Conservation Hatcheries* would establish new and expand existing  
5 conservation propagation programs for delta and longfin smelt. This conservation measure would  
6 have no effect on steelhead.

7 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing  
8 conservation propagation programs for delta and longfin smelt. This conservation measure would  
9 have no impact on steelhead. Consequently, no mitigation would be required

### 10 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

11 **NEPA Effects:** The effects of Urban stormwater treatment (CM19) would reduce contaminants  
12 associated with urban areas because it provides for the treatment of stormwater discharges. As  
13 discussed in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled  
14 *Pyrethroids, Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment  
15 would reduce urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and  
16 other contaminants. These reductions would contribute to improved water quality in the Delta.  
17 Based on the improved overall water quality conditions and reduced pesticides the effect would be  
18 beneficial.

19 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
20 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
21 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
22 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
23 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
24 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore,  
25 the impacts of urban stormwater treatment would be beneficial because it would have a beneficial  
26 effect both directly and through habitat modifications on steelhead. Consequently, no mitigation  
27 would be required.

### 28 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead** 29 **(CM21)**

30 **NEPA Effects:** There is no evidence of substantial entrainment of covered fish species at agricultural  
31 diversions in the Plan Area, but some entrainment likely is occurring. Whatever entrainment is  
32 occurring would be reduced by decommissioning agricultural diversions in the ROAs. PTM runs and  
33 extrapolations to a hypothetical number of diversions to be removed from the ROAs (i.e.,  
34 approximately 4–12% of diversions) estimated slight reductions in entrainment for delta smelt and  
35 longfin smelt. While the amount of reduced entrainment for steelhead might be lower, the effects  
36 would be beneficial.

37 **CEQA Conclusion:** There is no evidence of substantial entrainment of covered fish species at  
38 agricultural diversions in the Plan Area, but some entrainment likely is occurring. Whatever  
39 entrainment is occurring would be reduced by decommissioning agricultural diversions in the ROAs.  
40 PTM runs and extrapolations to a hypothetical number of diversions to be removed from the ROAs  
41 (i.e., approximately 4–12% of diversions) estimated slight reductions in entrainment for delta smelt

1 and longfin smelt. While the amount of reduced entrainment for steelhead might be lower the  
2 impacts would be beneficial because it would reduce entrainment which would have a positive  
3 impact on steelhead numbers. Consequently, no mitigation would be required.

## 4 **Sacramento Splittail**

### 5 **Construction and Maintenance of CM1**

#### 6 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento** 7 **Splittail**

8 Sacramento splittail eggs, larvae, juvenile young-of-the-year, and adult spawners could occur in the  
9 north Delta and east Delta in June and early July (see Table 11-4). Adult non-spawners could occur  
10 in the north Delta in October and November. In the south Delta, juveniles (yearlings), and adult non-  
11 spawners are present year round. Juvenile (young-of-the-year) fish are present in June to August,  
12 and adult spawners could be present in June and July (Wang 1986). Eggs and larvae could be  
13 present in June.

#### 14 ***Temporary Increases in Turbidity***

15 Sacramento splittail may be present in all of the Delta subregions during intake and barge landing  
16 construction. Because they typically inhabit turbid water, they are unlikely to be affected by  
17 temporary increases in turbidity. Potential increases in turbidity would also be minimized to the  
18 extent possible because of the limited duration of in-water construction activities, and implementing  
19 measures described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
20 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
21 *Control Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
22 *Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan)*. Pertinent details of  
23 these plans are provided under Impact AQUA-1 for delta smelt.

#### 24 ***Accidental Spills***

25 Potential impacts on Sacramento splittail from accidental spills during construction are similar to  
26 those discussed for delta smelt (see Impact AQUA-1). This impact would be minimized because of  
27 implementation of commitments described under Impact AQUA-1 for delta smelt and in Appendix  
28 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
29 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
30 *Containment, and Countermeasure Plan)*, which would minimize the potential for introduction of  
31 contaminants to surface waters and provide for effective containment and cleanup should accidental  
32 spills occur. Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

#### 33 ***Disturbance of Contaminated Sediments***

34 Impact AQUA-1 describes the potential for effects from disturbing contaminated sediments during  
35 construction, although turbidity, and in turn suspension of sediments, would be minimized by  
36 implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
37 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
38 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
39 *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*

1 *Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan*). Pertinent details of  
2 these plans are provided under Impact AQUA-1 for delta smelt.

3 As with delta smelt, it is concluded that BDCP restoration activities could generate potential  
4 unavoidable adverse effects on Sacramento splittail from selenium exposure relative to the NAA.  
5 While localized, short-term increases in copper concentrations are also possible, the removal of  
6 agricultural areas through restoration would eliminate some sources of copper, as well as for  
7 pesticides. Implementing *CM19 Urban Stormwater Treatment* would also reduce the discharge of  
8 pyrethroid pesticides to the Delta. Therefore, it is concluded that BDCP restoration activities will not  
9 generate adverse effects on Sacramento splittail from copper or pesticide exposure, relative to the  
10 NAA. Similarly, no appreciable addition or mobilization of ammonia to the aquatic system would  
11 result from restoration activities.

### 12 ***Underwater Noise***

13 As described under Impact AQUA-1, underwater sound generated by impact pile driving in or near  
14 surface waters can potentially harm Sacramento splittail. Small numbers of Sacramento splittail may  
15 be present in the vicinity of the pile driving activities. Should impact pile driving be required, the  
16 SEL<sub>cumulative</sub> threshold for injury could be exceeded. It is important to note that the impact would be  
17 realized only where piles must be impact driven, and vibratory pile driving would be the primary  
18 method used.

19 Table 11-4 illustrates the life stages of Sacramento splittail expected to be present in the north, east,  
20 and south Delta during the in-water construction window (expected to be June 1–October 31).  
21 Larval Sacramento splittail could occur in the vicinity of the intakes in June or early July, and  
22 juvenile Sacramento splittail could be in the vicinity of these sites in June, July, and possibly August  
23 during the in-water construction. The numbers of larval and juvenile Sacramento splittail are not  
24 known, but abundance is expected to be very low during these months. Larval and juvenile  
25 Sacramento splittail near the construction areas would be expected to be less than 2 grams and  
26 would move with the currents. If an individual larval or juvenile Sacramento splittail were present  
27 in the area affected by underwater sound from impact pile driving above the 183-dB SEL<sub>cumulative</sub>  
28 level, and proximate to an impact-driven pile, it could experience an adverse effect, such as injury or  
29 mortality.

30 The potential for Sacramento splittail to be exposed to impact pile driving noise would be relatively  
31 small, given the location of the intakes in the Sacramento River, the relatively small areas affected by  
32 underwater noise in the eastern and southern Delta, and the expected limited use of impact pile  
33 driving. Therefore, while individual larval and juvenile Sacramento splittail could experience an  
34 adverse effect (e.g., injury or mortality) from impact pile driving, the effect would be low because of  
35 their very low temporal and spatial distribution during construction, and because potential  
36 exposure above the threshold criterion would be intermittent and limited. In addition, no adverse  
37 effects are expected to occur on a population level. Mitigation Measures AQUA-1a and AQUA-1b  
38 would serve to further minimize the potential for adverse effects from underwater noise.

### 39 ***Fish Stranding***

40 In-water work activities have the potential to cause take of fish through the process of trapping and  
41 rescuing fish from construction areas. Sacramento splittail are found in the north Delta primarily  
42 during October through June. Spawning generally takes place upstream of the proposed intake  
43 facilities. Primarily larval and juvenile Sacramento splittail would be expected in the vicinity of the

1 intake facilities and barge landings, and typically during only 1 month (June) of the expected in-  
2 water work window. Therefore, Sacramento splittail have a low potential to be subjected to  
3 stranding and requiring removal from work areas. Should stranding occur, the implementation of a  
4 *Fish Rescue and Salvage Plan* (described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
5 *Environmental Commitments*) would minimize effects.

#### 6 ***In-Water Work Activities***

7 Although fish would likely avoid the noise and activity of pile installation and placement of riprap  
8 protection, these activities have the potential to result in direct impact. Dredging activities outside of  
9 the cofferdams to recontour the riverbed adjacent to the intakes would also have the potential to  
10 cause take. Because splittail are benthic feeders, they may become entrained in the dredge. Although  
11 the number of Sacramento splittail that could be affected by dredging is unknown, dredging  
12 activities would take place during months when splittail are rare in the area. Primarily larval and  
13 juvenile Sacramento splittail would be expected in the vicinity of the intake facilities and barge  
14 landings, and typically during only 1 month (June) of the expected in-water work window.  
15 Therefore, Sacramento splittail have a low potential to be subject to take from in-water work  
16 activities during construction. Furthermore, potential effects would be minimized by  
17 implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
18 in Appendix 3B, *Environmental Commitments*.

#### 19 ***Loss of Spawning, Rearing, or Migration Habitat***

20 There is no suitable spawning habitat for splittail in the vicinity of the proposed in-water work;  
21 therefore splittail spawning habitat would not be affected by construction activities. Intake  
22 construction and associated channel dredging would result in a permanent loss of up to  
23 approximately 8,300 lineal feet of channel margin in low-quality rearing and migration habitat.  
24 While this is a loss of rearing habitat, the overall effects would be limited due to the poor quality of  
25 the existing habitat. In addition, implementation of *CM6 Channel Margin Enhancement* would  
26 enhance channel margin habitat along 20 miles of the Sacramento River, including the vicinity of the  
27 intake structures, and would be designed to result in a net improvement in channel margin habitat  
28 function.

29 As described in Impact AQUA-1, at the six barge landings, there would be in-water and over-water  
30 structures for several year each while the tunnel is constructed. The barge landings would each  
31 occupy approximately 15,000 square feet of shoreline habitat within their respective delta channels.  
32 However, development and implementation of a barge operations plan (see Impact AQUA-1 and  
33 Appendix 3B, *Environmental Commitments: Barge Operations Plan*), would minimize potential effects  
34 of construction and operations of the barge landings on splittail habitat.

#### 35 ***Predation***

36 Construction of in-water and over-water structures and local temporary increases in turbidity  
37 associated with construction may affect predation on various fish species, including Sacramento  
38 splittail. Although there would be a very slight increase in predator refuge during construction, it  
39 would not notably increase predator refuge within the Delta. This impact would not be adverse  
40 because the areas constructed are relatively small and the level of predation would not have  
41 population level effects.

1 **Summary**

2 In-water construction activities would be scheduled to occur when the least numbers of Sacramento  
3 splittail would be present in or near the construction areas. Implementation of environmental  
4 commitments *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
5 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
6 *Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material* (see  
7 Appendix 3B)—as well as the species' tolerance to turbidity—would minimize effects of  
8 construction activities on turbidity, accidental spills, onsite and offsite sediment transport to surface  
9 waters, and re-suspension and redistribution of potentially contaminated sediments. Pertinent  
10 details of these plans are provided under Impact AQUA-1 for delta smelt. As a result, these effects  
11 would not be adverse to Sacramento splittail.

12 The low numbers of splittail that would likely be present during the expected in-water work  
13 window would also minimize the potential effects of in-water construction activities (including  
14 impact pile driving). The relatively low incidence of impact pile driving expected, and  
15 implementation of the avoidance and minimization measures included in Mitigation Measures  
16 AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g.,  
17 injury or mortality). Implementation of environmental commitments, such as a *Fish Rescue and*  
18 *Salvage Plan* and *Barge Operations Plan* (as described under Impact AQUA-1 for delta smelt and in  
19 Appendix 3B), would also offset potential effects of construction activities on splittail. Construction  
20 of the approach canal and Byron Tract Forebay would not affect fish-accessible waterways and  
21 therefore would not affect splittail. As a result, these construction activities would not result in  
22 adverse effects on Sacramento splittail.

23 Locally increased predator habitat and predation from the temporary construction structures  
24 (cofferdams and barge landing docks) would not have population level effects, because splittail  
25 typically occur offshore and in open water habitat. Therefore, predation effects on splittail from  
26 construction activities would not be adverse.

27 **NEPA Effects:** The effects would not be adverse for Sacramento splittail.

28 **CEQA Conclusion:** Because they typically inhabit turbid water, Sacramento splittail are unlikely to  
29 be affected by temporary increases in turbidity. Potential impacts from turbidity, accidental spills,  
30 and resuspension of sediments that may contain toxic contaminants would be limited because  
31 exposure would be minimized through the control of turbidity as described for delta smelt Impact  
32 AQUA-1 including implementation of the measures described under Impact AQUA-1 for delta smelt  
33 and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
34 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
35 *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*  
36 *Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan*), and Sacramento  
37 splittail abundance would be low near active in-water construction sites. Consequently, these  
38 impacts would be less than significant.

39 Although only a limited occurrence of splittail is expected in the construction areas the direct effects  
40 of underwater construction noise on them would be a significant impact because of the high  
41 likelihood that it would cause injury or death to most impacted fish in the immediate vicinity of the  
42 activity. However, Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for  
43 effects from underwater noise and would reduce the severity of impacts to a less-than-significant  
44 level. Fish stranding is also expected to be limited because of the low potential for Sacramento

1 splittail to be present. Other in-water construction activities also have a limited potential to affect  
2 splittail. While construction and channel dredging would temporarily disturb benthic habitat and  
3 would result in a permanent rearing habitat loss of up to approximately 8,300 lineal feet of channel  
4 margin within splittail rearing habitat, fish passage and migration would not be substantially  
5 affected by this temporary or permanent loss of habitat. There would be no impact on splittail  
6 spawning habitat.

7 *CM6 Channel Margin Enhancement* would enhance channel margin habitat along 20 miles of the  
8 Sacramento River, including the vicinity of the intake structures, and would be designed to result in  
9 a net improvement in channel margin habitat function. Because of the low quality of the existing  
10 habitat and proposed enhancement under *CM6 Channel Margin Enhancement*, and implementation  
11 of the commitments identified in Appendix 3B, *Environmental Commitments*, the overall impact of  
12 construction activities would be less than significant, and no additional mitigation would be  
13 required.

14 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
15 **of Pile Driving and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 from delta smelt.

17 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
18 **and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

20 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
21 **Splittail**

22 ***Temporary Increases in Turbidity***

23 As discussed above for construction effects (Impact AQUA-109), Sacramento splittail inhabit  
24 naturally turbid waters, and would not be affected by a short-term increase in turbidity. Turbidity  
25 effects would be minimized by implementation of environmental commitments described under  
26 Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments (Environmental*  
27 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
28 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of*  
29 *Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge*  
30 *Operations Plan)*. Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

31 ***Accidental Spills***

32 Effects on Sacramento splittail from accidental spills during maintenance would be the same as  
33 those discussed for delta smelt (see Impact AQUA-2). Effects would be minimized by  
34 implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
35 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
36 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
37 *Prevention, Containment, and Countermeasure Plan)*. Pertinent details of these plans are provided  
38 under Impact AQUA-1 for delta smelt.

1       **Underwater Noise**

2       As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
3       maintenance activities are not expected to reach a level that would harm juvenile or adult fishes.  
4       The potential noise from in-water maintenance activities would not exceed the threshold sound  
5       pressure level and would be temporary. In addition, the in-water work would be conducted when  
6       the least number of Sacramento splittail are likely to be present.

7       **In-Water Work Activities**

8       The potential effects of in-water maintenance activities would be similar to those discussed for  
9       construction-related effects on Sacramento splittail (see Impact AQUA-109). Direct injury and  
10      mortality of Sacramento splittail are most likely to occur during dredging activities around the new  
11      intakes. Suction dredging and mechanical excavation can capture or crush fish, causing injury or  
12      mortality. Sacramento splittail may use both main channel areas and nearshore areas during rearing  
13      or migration. Because splittail are benthic feeders, they may become entrained in the dredge.  
14      Sacramento splittail may be migrating downstream in June in the Sacramento River. Maintenance  
15      dredging would occur infrequently and be of short duration. Although the number of Sacramento  
16      splittail that could be affected by dredging is unknown, maintenance dredging would take place  
17      during months when adult splittail are rare in the area. Potential effects would be minimized by  
18      implementation of environmental commitments described under Impact AQUA-1 for delta smelt and  
19      in Appendix 3B, *Environmental Commitments*.

20      **Loss of Spawning, Rearing, or Migration Habitat**

21      Two maintenance activities, dredging and riprap placement, would reduce habitat values in the area  
22      around the intakes and levees. Removal of sediment would decrease the number of  
23      macroinvertebrates around the intakes. Splittail are benthic feeders, so removal of  
24      macroinvertebrates via dredging could affect prey abundance. However, only a small amount of  
25      sediment would be dredged compared to the entire area, and other foraging is readily accessible to  
26      splittail in the immediate area.

27      Sacramento splittail habitat near the intake structures is used for rearing and migration. A small  
28      area of rearing habitat could be affected due to the placement of riprap. Migration habitat would be  
29      available farther out in the channel and would be unaffected by dredging or riprap placement.  
30      Available rearing and migration habitat of similar quantity and quality would be readily accessible  
31      to Sacramento splittail in the immediate vicinity. Effects would be minimized by implementation of  
32      environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
33      *Environmental Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of Spoils, Reusable*  
34      *Tunnel Material, and Dredged Material*; and *Barge Operations Plan*.

35      **Predation**

36      Maintenance activities would be unlikely to have any measurable effect on Sacramento splittail  
37      predation rates. These activities may include the use of barges and other watercraft that could  
38      theoretically provide cover, shelter, and perching areas for delta smelt predators. However, the  
39      limited duration of maintenance activities and the associated noise and disturbance would be  
40      expected to dissuade predators from concentrating at sufficient density to measurably affect  
41      predation rates on Sacramento splittail.

1       **Summary**

2       In-water maintenance activities would be scheduled to occur when the least numbers of Sacramento  
3       splittail would be present in or near the maintenance areas. In addition, Sacramento splittail are  
4       tolerant to increases in turbidity, which might occur during maintenance activities. Such activities  
5       would include maintenance dredging at the intake sites, and installation or repair of riprap bank  
6       armoring. These activities would remove or decrease the number of macroinvertebrates around the  
7       intakes, which would reduce prey abundance; however, other foraging habitat is available in the  
8       immediate area. Implementation of the environmental commitments described in Appendix 3B,  
9       *Environmental Commitments*, would further minimize or eliminate effects on Sacramento splittail by  
10      limiting turbidity increases, and by guiding the rapid and effective response in the case of  
11      inadvertent spills of hazardous materials. These environmental commitments include  
12      *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
13      *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;* and  
14      *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans  
15      are provided under Impact AQUA-1 for delta smelt.

16      Implementation of these environmental commitments, along with the low numbers of Sacramento  
17      splittail expected to occur in the maintenance areas during the expected in-water work windows,  
18      and the limited frequency and duration of in-water maintenance activities would result in a very low  
19      potential for adverse effects on Sacramento splittail. In addition, little or no spawning habitat occurs  
20      in the areas potentially affected by maintenance activities, and ample rearing, and migration habitat  
21      of the same quality is readily accessible in the area, and this habitat would not be affected by  
22      maintenance activities.

23      **NEPA Effects:** As a result, the short-term maintenance activities would not adversely affect  
24      Sacramento splittail.

25      **CEQA Conclusion:** As described above, Sacramento splittail inhabit naturally turbid water and are  
26      not expected to be affected by temporary increases in turbidity during maintenance activities. In  
27      addition to the limited frequency and duration of in-water maintenance activities and  
28      implementation of commitments identified above and described in detail under Impact AQUA-1 for  
29      delta smelt and in Appendix 3B, *Environmental Commitments*, would minimize the potential for  
30      maintenance activities to affect Sacramento splittail by limiting turbidity increases, and by guiding  
31      the rapid and effective response in the case of inadvertent spills of hazardous materials. These  
32      environmental commitments are *Environmental Training; Stormwater Pollution Prevention Plan;*  
33      *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
34      *Containment, and Countermeasure Plan;* and *Disposal of Spoils, Reusable Tunnel Material, and*  
35      *Dredged Material*. Potential changes to habitat would also be limited and temporary. Therefore, the  
36      potential impact of maintenance activities is considered less than significant because it would not  
37      substantially reduce Sacramento splittail habitat, restrict its range, or interfere with its movement.  
38      Consequently, no mitigation would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

3 ***Water Exports from SWP/CVP South Delta Facilities***

4 Juvenile splittail are vulnerable to entrainment at the south Delta export facilities primarily from  
5 May through July, during their downstream emigration from floodplain rearing and spawning  
6 habitats. Salvage of adult splittail often increases abruptly following the first flush during December  
7 through March. The level of entrainment is strongly influenced by abundance, which varies greatly  
8 from year to year (Sommer et al. 1997). Adult salvage numbers are relatively high during years of  
9 high outflow, when exports are high, and likely to be high 1–3 years after years that produced strong  
10 year classes of splittail.

11 Two methods were used to estimate juvenile splittail entrainment, both of which were designed to  
12 account for the very large effect of abundance on entrainment (detailed in *BDCP Effects Analysis –*  
13 *Appendix 5B Entrainment, Section B.5.4.5, hereby incorporated by reference*). One method uses  
14 February-June Delta inflow as a proxy for splittail abundance, based on the observed correlation  
15 between historical inflow and salvage density, while the other uses days of Yolo Bypass inundation  
16 as a proxy for abundance, based on the observed correlation between days of inundation and  
17 salvage density. The inflow method more closely estimates entrainment rate (i.e., per capita  
18 entrainment), while the inundation method more closely estimates total entrainment. Consequently,  
19 estimates based on the inflow method are more directly related to the level of exports at the south  
20 Delta facilities during May-July. Alternative 1A is expected to have a much greater effect on days of  
21 Yolo Bypass inundations, which would be increased due to implementation of CM2 (see Impact  
22 AQUA-112), than on Delta inflow.

23 *Juvenile Sacramento Splittail—Delta Inflow -Estimated Salvage Density*

24 Salvage generally was estimated to decrease under Alternative 1A scenarios relative to NAA,  
25 reflecting the general decrease in SWP/CVP south Delta pumping. Across all water years, reductions  
26 in estimated salvage under Alternative 1A scenarios compared to NAA at both facilities ranged from  
27 just over 40% to approximately 85%. Given that the bulk of salvage occurs in wet years, the results  
28 for wet years were very similar to those for all years. In contrast, reductions under Alternative 1A in  
29 above-normal years were low at approximately 3–15%, and in one instance, salvage under  
30 Alternative 1A increased relative to NAA by 11%. In the remaining water-year types (below-normal,  
31 dry, and critical), reductions in salvage under Alternative 1A relative to NAA generally were in the  
32 range of 25–60%.

33 *Juvenile Sacramento Splittail—Yolo Bypass Inundation-Estimated Salvage Density*

34 Across all water years, May–July salvage of juvenile Sacramento splittail under Alternative 1A  
35 (A1A\_LLT) was generally several times higher at the CVP facilities than the SWP facilities, with the  
36 differences in salvage estimates between the facilities diminishing with lower Delta inflow. Salvage  
37 estimates ranged from averages of hundreds of thousands or millions in wet water years, through  
38 tens or hundreds of thousands in above-normal years, thousands to tens of thousands in below  
39 normal water years, and thousands in dry water years, to hundreds in critical water years.

40 In contrast to estimates of salvage from Delta inflow (see above), salvage from days of Yolo Bypass  
41 inundation generally was estimated to increase considerably under Alternative 1A scenarios relative

1 to NAA, reflecting the increased inundation of the Yolo Bypass under Alternative 1A scenarios.  
2 Across all water years, increases in estimated salvage under Alternative 1A scenarios compared to  
3 NAA at both facilities ranged from approximately 150 to 400%. Given that the bulk of salvage occurs  
4 in wet years, the results for wet years were very similar to those for all years. Increases in estimated  
5 salvage under Alternative 1A were greatest in above-normal years, at approximately 900–1,300%  
6 more than NAA. There were generally reductions in salvage under Alternative 1A scenarios  
7 compared to NAA in critical water years, ranging from averages of 1 to 60%. In the remaining water-  
8 year types (below-normal and dry), average increases in salvage under Alternative 1A relative to  
9 NAA ranged from 20 to 630%.

#### 10 *Sacramento Splittail Adults— Salvage Density Method*

11 The main entrainment period for adult Sacramento splittail occurs December to March. General  
12 trends in estimated salvage for adult Sacramento splittail include higher salvage at the SWP than the  
13 CVP and decreasing salvage as water years become drier. Salvage under the Alternative 1A scenarios  
14 was 62-66 % lower than baseline scenarios, but the differences decreased as water years become  
15 drier.

16 Average salvage across all water years found consistent decreases under Alternative 1A (A1A\_LL1T)  
17 of 65% (2,200 fewer adult Sacramento splittail compared to NAA. Adult salvage would decrease  
18 under Alternative 1A scenarios compared to NAA for wet years (3,700 fish; 91% less), above-normal  
19 years (3,900 fish; 81% less), below-normal years (1,500 fish; 49% less), and dry years (250 fish;  
20 11% less). In critical years, salvage was low. SWP salvage would peak in November and February  
21 and be lower in April and May, while CVP salvage would peak in October and November under all  
22 model scenarios.

#### 23 *Water Exports from SWP/CVP North Delta Intake Facilities*

24 Potential entrainment at the north Delta intakes occurs only under the action alternatives, including  
25 Alternative 1A, because there are no north Delta intakes operational under NAA. The north Delta  
26 intakes would be screened, and analysis indicates that splittail larvae less than 10 mm long would be  
27 vulnerable to entrainment (*BDCP Effects Analysis – Appendix 5B Entrainment, Section B.6.2.4, hereby*  
28 *incorporated by reference*). Very little is known of splittail densities in this area, so monitoring will  
29 determine their extent. The project’s adaptive management plan includes monitoring of the new  
30 screens to determine their effectiveness. If the screens are not meeting expectations, additional  
31 measures may be implemented to improve screen performance, such as modifications to the screens  
32 or other structural components at the intakes, or changes in water diversion operations to reduce  
33 entrainment or impingement.

#### 34 *Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct*

35 Entrainment of Sacramento splittail at the North Bay Aqueduct has not been explicitly analyzed.  
36 However, the Barker Slough Pumping Plant is screened for fish greater than 25mm long and the  
37 alternative intake would presumably have screens of 1.75-m mesh and therefore it would exclude  
38 splittail greater than 10mm, based on north Delta intake analysis. Entrainment to the NBA would be  
39 similar or reduced compared to NAA once the alternative intake on the Sacramento River is  
40 established. Shifting NBA exports away from Barker Slough, which is near important splittail  
41 spawning habitat in the Yolo Bypass region, to the lower Sacramento River may reduce entrainment  
42 risk of larval splittail.

### 1 **Predation Associated with Entrainment**

2 Predation can occur in association with the various types of structures such as intakes that may  
3 provide cover for predators or affect prey behavior in a way that enhances predation success. For  
4 example, the risk of predation mortality within CCF is assumed to be approximately 75% based on  
5 mark-recapture studies on other fish species (Gingras 1997; Clark et al. 2009; Castillo et al. 2012),  
6 and the risk of predation associated with the CVP trash racks is assumed to be 15% (National  
7 Marine Fisheries Service 2009). The reduced per capita entrainment of juvenile Sacramento splittail  
8 to the south Delta under Alternative 1A is expected to concomitantly reduce these predation losses,  
9 compared to Existing Conditions.

10 Juvenile Sacramento splittail would be vulnerable to increased predation mortality in the vicinity of  
11 the proposed north Delta intake locations during their emigration from upstream spawning habitats  
12 on the Sacramento River such as the Sutter Bypass. However, juvenile splittail are strong swimmers  
13 and move rapidly through the lower river on their way to the delta. Splittail do not appear to be a  
14 substantial part of the diet of striped bass around the Sacramento River reach where the proposed  
15 north Delta intakes would be sited. Results of striped bass diet studies conducted by Thomas (1967)  
16 showed that no Sacramento splittail were observed in the striped bass sampled. Stevens (1963) also  
17 conducted diet studies on striped bass in the reach of the Sacramento River upstream of Rio Vista  
18 and found splittail in the diet of striped bass. However, he reported only 1.4% of the striped bass  
19 stomachs that contained food had splittail, representing 1% of the diet of striped bass in July.  
20 Sacramento splittail were not observed by Stevens in the diet of striped bass in other months of the  
21 year. For purposes of this assessment, it is assumed that juvenile splittail would be vulnerable over a  
22 4-month period in the late spring and summer (April–July) when, on average, nearly all juvenile  
23 splittail emigrate.

24 These observations support the conclusion reported in the *BDCP Effects Analysis – Appendix B,*  
25 *Entrainment (hereby incorporated by reference)*. Based on analyses in the BDCP and consultation  
26 with the fishery managers it was concluded that the overall effect was a low overall reduction in  
27 predation effects on splittail primarily due to the reduction in predation at the South Delta pumps  
28 and a possible but negligible increase in predation at the North Delta facility. Further the conclusion  
29 of the agencies was that the predation was not a factor currently limiting splittail abundance. Hence  
30 the overall conclusion is that Alternative 1A would have no predation effect on splittail.

31 **NEPA Effects:** The two different modeling techniques for estimating entrainment (represented by  
32 salvage) of Sacramento splittail at the south Delta facilities gave opposite results. The Delta inflow  
33 method estimated substantially less salvage under Alternative 1A compared to NAA because of  
34 reduced pumping in the south Delta under Alternative 1A. In contrast, the Yolo Bypass days of  
35 inundation method estimated substantial increases (several-fold to an order of magnitude or more)  
36 in the number of Sacramento splittail entrained in most water-year types. This would occur because  
37 of increased accessibility to floodplain habitat for spawning and early rearing, leading to more  
38 juvenile splittail occupying the Plan Area. However, the general decrease in export pumping from  
39 the south Delta during the main May–July entrainment period for juvenile splittail would result in a  
40 lower overall proportion of the splittail population being entrained. Splittail would be exposed to  
41 entrainment and predation risk at the north Delta intakes, but this would be offset by the reduction  
42 in per capita entrainment and associated predation at the south Delta facilities as well as increased  
43 production of juveniles. Consequently, the overall effect of Alternative 1A would not be adverse.

1 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
2 SWP/CVP south Delta facilities would not result in an overall increase in per capita entrainment for  
3 Sacramento splittail, although water exports from SWP/CVP north Delta intake facilities would  
4 result in an increase in larval entrainment or a loss of individuals from predation at that location.  
5 The overall reductions in entrainment at the south Delta, and the additional production of juvenile  
6 splittail from increased inundation of the Yolo Bypass under CM2, would offset the potential losses  
7 at the north Delta facilities. Therefore, impacts of Alternative 1A on entrainment are considered less  
8 than significant because there would be no substantial reduction in numbers. Consequently, no  
9 mitigation would be required.

#### 10 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 11 **Sacramento Splittail**

12 In general, Alternative 1A would have beneficial effects on splittail spawning habitat relative to NAA  
13 by increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be  
14 negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins  
15 Slough and the Feather River, and negligible effects on water temperatures in the Feather River,  
16 relative to NAA. There would be beneficial effects on spawning conditions in channel margin and  
17 side-channel habitats from increases in mean monthly flow during the spawning period in both the  
18 Sacramento River and the Feather River.

#### 19 ***Floodplain Habitat***

20 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream  
21 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning  
22 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not  
23 inundated, spawning in side channels and channel margins would be much more critical. Effects of  
24 Alternative 1A on floodplain spawning habitat were evaluated for Yolo Bypass. Increased flows into  
25 Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the Sutter Bypass  
26 (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects in Yolo Bypass  
27 were evaluated using a habitat suitability approach based on water depth (2 m threshold) and  
28 inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow  
29 velocity was generally very low throughout the modeled area for most conditions, with generally 80  
30 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable  
31 critical velocity for early life stages of splittail; Young and Cech 1996).

32 The proposed changes to the Fremont weir would increase the frequency and duration of Yolo  
33 Bypass inundation events compared to NAA. Only the inundation events lasting more than 30 days  
34 are considered biologically beneficial to splittail, so are the focus of the analyses provided here.  
35 A1A\_LL1 compared to NAA for the drier type years (below normal, dry, and critical), results in an  
36 increase in the frequency of events greater than 30 days compared to NAA over the 82-year  
37 simulation period (Figure 11-1A-5, Table 11-1A-59). These results indicate that overall project-  
38 related effects on occurrence of various duration inundation events would be beneficial for splittail  
39 spawning by creating better spawning habitat conditions.

1 **Table 11-1A-59. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**  
 2 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**  
 3 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>30-49 Days</b>		
Wet	-4	-2
Above Normal	0	0
Below Normal	5	5
Dry	2	2
Critical	1	1
<b>50-69 Days</b>		
Wet	-5	-5
Above Normal	-1	-1
Below Normal	2	2
Dry	0	0
Critical	0	0
<b>≥70 Days</b>		
Wet	8	7
Above Normal	3	3
Below Normal	1	1
Dry	0	0
Critical	0	0

4

5 In terms of acreage of suitable splittail habitat in Yolo Bypass, there would be increases ranging  
 6 from 5 to 983 acres. For wet, above normal, and below normal water years there would be project-  
 7 related increases (A1A\_LLT compared to NAA) of 59%, 68%, and 296% for wet, above normal, and  
 8 below normal water years, respectively (Table 11-1A-60). The project-related increases for dry and  
 9 critical years (15 and 5 acres, respectively) would establish small areas of suitable spawning habitat  
 10 during these water year types compared to no suitable habitat under baseline conditions. These  
 11 results indicate that increases in inundated acreage in each water year type would result in  
 12 increased habitat and have a beneficial effect on splittail spawning. The largest increases on a  
 13 percentage basis would be particularly large in drier year types, when, historically, availability of  
 14 this habitat has been especially low.

1 **Table 11-1A-60. Increase in Splittail Weighted Habitat Area (acres and percent) in Yolo Bypass**  
 2 **from Existing Biological Conditions to Alternative 1A by Water Year Type from 15 2-D and Daily**  
 3 **CALSIM II Modeling Runs**

Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Wet	1,100 (71%)	983 (59%)
Above Normal	766 (67%)	772 (68%)
Below Normal	359 (274%)	366 (296%)
Dry	15 (NA)	15 (NA)
Critical	5 (NA)	5 (NA)

NA = percent differences could not be computed because no splittail weighted habitat occurred in the bypass for NAA and EXISTING CONDITIONS in those years (dividing by 0).

4  
 5 A potential adverse effect of Alternative 1A that is not included in the modeling is reduced  
 6 inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The  
 7 Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted  
 8 from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers.  
 9 comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened  
 10 notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir.  
 11 A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont  
 12 Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although  
 13 understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In  
 14 any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of  
 15 inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the  
 16 river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass  
 17 inundation is poorly known. Despite this uncertainty, it is evident that *CM2 Yolo Bypass Fisheries*  
 18 *Enhancement* has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on  
 19 splittail production due to effects on Sutter Bypass inundation. Splittail use the Sutter Bypass for  
 20 spawning and rearing as they do the Yolo Bypass.

21 ***Channel Margin and Side-Channel Habitat***

22 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel  
 23 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,  
 24 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are  
 25 affected by changes in flow because greater flows cause more flooding, thereby increasing  
 26 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially  
 27 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are  
 28 expected to be most important to the splittail population because in years of high-flows, when most  
 29 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively  
 30 little production.

31 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions  
 32 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the  
 33 Sacramento River for the time-frame February through June. These are the most important months  
 34 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from  
 35 the side-channel habitats during May and June if conditions become unfavorable.

1 Differences between model scenarios for monthly average flows during February through June by  
2 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather  
3 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 For the Sacramento River at Wilkins Slough, flows during February through April under A1A\_LLT  
5 would be similar to flows under NAA. During May and June, flows under A1A\_LLT would be up to  
6 25% greater than flows under NAA, resulting in a beneficial effect on rearing conditions.

7 For the Feather River at the confluence, flows during February and June under A1A\_LLT would be  
8 up to 44% greater than flows under NAA, resulting in a beneficial effect on spawning conditions.

9 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather  
10 River at the confluence with the Sacramento River, respectively were used to investigate the  
11 potential effects of Alternative 1A on the suitability of water temperatures for splittail spawning and  
12 egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and  
13 egg incubation.

14 There would be no biologically meaningful difference (>5% absolute scale) between NAA and  
15 Alternative 1A in the frequency of water temperatures in the Sacramento and Feather Rivers being  
16 within the suitable 45°F to 75°F regardless of water year type (Table 11-1A-61).

17 Overall effects of Alternative 1A on flow consist of negligible effects (<5%) attributable to the  
18 project or beneficial effects on spawning conditions through increases in mean monthly flow in the  
19 Sacramento and Feather rivers and no change in occurrence of critical high or critically low water  
20 temperatures in the Feather River.

1 **Table 11-1A-61. Difference (Percent Difference) in Percent of Days or Months<sup>a</sup> during February to**  
 2 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**  
 3 **Hamilton City and Feather River at the Confluence with the Sacramento River<sup>b</sup>**

	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>Sacramento River at Hamilton City</b>		
<i>Temperatures below 45°F</i>		
Wet	-3 (-61%)	0 (0%)
Above Normal	-3 (-63%)	0.1 (9%)
Below Normal	-3 (-52%)	0 (0%)
Dry	-1 (-45%)	-0.04 (-4%)
Critical	-1 (-51%)	0.1 (13%)
All	-2 (-56%)	0.01 (1%)
<i>Temperatures above 75°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<b>Feather River at Sacramento River Confluence</b>		
<i>Temperatures below 45°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<i>Temperatures above 75°F</i>		
Wet	2 (NA)	1 (14%)
Above Normal	2 (NA)	-2 (-20%)
Below Normal	1 (NA)	-4 (-38%)
Dry	6 (125%)	0 (0%)
Critical	5 (300%)	2 (11%)
All	3 (260%)	-0.5 (-4%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Days were used in the Sacramento River and months were used in the Feather River.

<sup>b</sup> Based on the modeling period of 1922 to 2003.

4

5 **Stranding Potential**

6 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,  
 7 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and  
 8 historical data to evaluate possible stranding effects, the following provides a narrative summary of  
 9 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,

1 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the  
 2 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial  
 3 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.  
 4 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding  
 5 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while  
 6 keeping water away from other areas to reduce stranding in isolated ponds. Actions under  
 7 Alternative 1A to increase the frequency of Yolo Bypass inundation would increase the frequency of  
 8 potential stranding events. For splittail, an increase in inundation frequency would also increase the  
 9 production of Sacramento splittail in the bypass. While total stranding losses may be greater under  
 10 Alternative 1A than under NAA, the total number of splittail would be expected to be greater under  
 11 Alternative 1A.

12 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement  
 13 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands  
 14 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may  
 15 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the  
 16 potential improvements in habitat capacity outweighed the potential stranding problems that may  
 17 exist in some years. Overall, these effects are not adverse.

18 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
 19 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
 20 of egg mortality. The effects of Alternative 1A on splittail spawning habitat are primarily beneficial.  
 21 There would be benefits due to increased inundation in the Yolo Bypass that would increase the  
 22 quantity and quality of spawning habitat there, and benefits to channel margin and side-channel  
 23 habitat in the Sacramento River and Feather River from increases in mean monthly flow and  
 24 decreases in high water temperatures during the spawning period.

25 **CEQA Conclusion:**

26 In general, Alternative 1A would have beneficial effects on splittail spawning habitat relative to  
 27 Existing Conditions by increasing the quantity of spawning habitat in the Yolo Bypass through  
 28 increased acreage subjected to periodic inundation.

29 **Floodplain Habitat**

30 Comparisons of splittail weighted habitat area for Alternative 1A and Existing Conditions indicate  
 31 that there would be an increase in shorter events (30-49 days) in drier water year types and longer  
 32 duration events ( $\geq 70$  days) in wetter water year types under A1A\_LL1 relative to Existing  
 33 Conditions (Table 11-1A-59). There would be a reduction in the number of events under A1A\_LL1 of  
 34 short and mid-range durations (30-49 days and 50-69 days) during wet years primarily.

35 Alternative 1A would result in increased acreage of suitable spawning habitat compared to Existing  
 36 Conditions (Table 11-1A-60), with increases of between 5 and 1,100 acres of suitable spawning  
 37 habitat depending on water year type. Increased areas for wet, above normal, and below normal  
 38 water years are predicted to be 71%, 67%, and 274%, respectively, for Alternative 1A. Comparisons  
 39 for dry and critical water years indicate project-related increases of 15 and 5 acres of suitable  
 40 spawning habitat, respectively, compared to 0 acres for Existing Conditions. These results indicate  
 41 that Alternative 1A would have beneficial effects on splittail habitat through increasing spawning  
 42 habitats by up to 274%.

1 **Channel Margin and Side-Channel Habitat**

2 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions  
3 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the  
4 Sacramento River for the February through June splittail spawning and early life stage rearing  
5 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT in  
6 the Sacramento River at Wilkins Slough would be similar to flows under Existing Conditions during  
7 February and March. During April through June, flows under A1A\_LLT would generally be greater  
8 than flows under Existing Conditions.

9 In the Feather River at the confluence with the Sacramento River, flows under A1A\_LLT would  
10 generally be up to 29% greater than flows under existing conditions during February through April,  
11 similar to flows under Existing Conditions during May, and up to 19% lower than flows under  
12 Existing Conditions during June.

13 There would generally be no biologically meaningful difference (>5% absolute scale) between  
14 Existing Conditions and Alternative 1A in the frequency of water temperatures in the Sacramento  
15 and Feather Rivers being within the suitable 45°F to 75°F, except in dry and critical water years (5%  
16 to 6% greater) for the 75°F threshold in the Feather River (Table 11-1A-61).

17 **Stranding Potential**

18 Because there would be little difference in flow conditions between Alternative 1A and Existing  
19 Conditions, the project would not have biologically meaningful effects on stranding potential.

20 **Summary of CEQA Conclusion**

21 Overall, these results indicate that the impact is less than significant because it would not  
22 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
23 of egg mortality. This conclusion is largely a result of increasing the quantity of spawning habitat in  
24 the Yolo Bypass through increased acreage subjected to periodic inundation. No mitigation is  
25 necessary.

26 **Impact AQUA-113: Effects of Water Operations-on Rearing Habitat for Sacramento Splittail**

27 **NEPA Effects:** In general, Alternative 1A would have beneficial effects on splittail rearing habitat  
28 relative to NAA based on an increase in the quantity and quality of rearing habitat in the Yolo  
29 Bypass, beneficial effects on rearing conditions in channel margin and side-channel habitats in the  
30 Sacramento River and the Feather River, and reductions in the occurrence of critical high water  
31 temperatures in the Feather River in wetter water year types.

32 Sacramento splittail rear in floodplain and main-channel environments; the analyses of splittail  
33 weighted habitat area in Yolo Bypass and effects of flow conditions on channel margin and side-  
34 channel habitats provided in the previous impact, Impact AQUA-112, apply to rearing as well as  
35 spawning habitat for splittail. As concluded above, the effect is not adverse because it would not  
36 substantially reduce suitable rearing habitat or substantially reduce the number of fish as a result of  
37 juvenile mortality. Effects of Alternative 1A on flow would have beneficial effects on the availability  
38 of channel margin and main-channel habitat through increases in mean monthly flow for some  
39 months and water year types during the rearing period. Increased flows into Yolo Bypass may  
40 reduce flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create  
41 habitat in the Yolo Bypass that would have a beneficial effect on rearing conditions.

1 **CEQA Conclusion:** In general, Alternative 1A would have beneficial effects on splittail rearing habitat  
2 relative to the Existing Conditions by increasing the quantity of rearing habitat in the Yolo Bypass,  
3 and increases in mean monthly flow for some months and water year types in the Sacramento River  
4 and the Feather River.

5 Project effects on splittail rearing habitat would be similar to those described for spawning habitat  
6 in the previous impact discussion, Impact AQUA-112. As concluded above, the impact is less than  
7 significant because it would not substantially reduce suitable rearing habitat or substantially reduce  
8 the number of fish as a result of juvenile mortality and no mitigation is necessary. Effects of  
9 Alternative 1A on flow would not have negative effects on the availability of channel margin and  
10 main-channel habitat, and would have a beneficial effect through increases in mean monthly flow for  
11 some months and water year types during the rearing period. Increased flows into Yolo Bypass may  
12 reduce flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create  
13 habitat in the Yolo Bypass that would have a beneficial effect on rearing conditions.

14 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
15 **Splittail**

16 In general, effects of Alternative 1A would not affect splittail migration conditions in the Sacramento  
17 River or the Feather River relative to NAA based on negligible or beneficial effects on mean monthly  
18 flow during the migration period (February through June) and negligible or beneficial effects on  
19 water temperatures in the Feather River.

20 The effects of Alternative 1A on splittail migration conditions would be the same as described for  
21 channel margin and side-channel habitats in the Sacramento River and Feather River for Impact  
22 AQUA-112 above. There would be benefits to channel margin and side-channel habitat in both  
23 locations from increases in mean monthly flow and decreases in high water temperatures compared  
24 to baseline conditions.

25 **NEPA Effects:** The effect of Alternative 1A is not adverse because it would not substantially reduce  
26 or degrade migration habitat or substantially reduce the number of fish as a result of mortality.  
27 Similarly, because OMR flows are overall improved, the effect of Alternative 1A on through-Delta  
28 migration conditions for Sacramento splittail would be beneficial.

29 **CEQA Conclusion:** In general, effects of Alternative 1A would not affect splittail migration conditions  
30 in the Sacramento River during February through June relative to the Existing Conditions, but would  
31 reduce the suitability of channel conditions for migration in the Feather River due to increased  
32 exposure to critical water temperatures. However, splittail spawning in the Feather River is not as  
33 important as in Yolo Bypass, and therefore, net effects from Alternative 1A on migration conditions  
34 in the Feather River would be negligible.

35 Effects of Alternative 1A on splittail migration conditions would be similar to those described for  
36 channel margin and side-channel habitats in Impact AQUA-112. As concluded above, the impact is  
37 not significant because it would not substantially reduce suitable migration habitat or substantially  
38 reduce the number of fish as a result of mortality and no mitigation is necessary. Effects of  
39 Alternative 1A on flow would not have negative effects on the availability of channel margin and  
40 main-channel habitat, and would have a beneficial effect through increases in mean monthly flow for  
41 some months and water year types during the migration period. Benefits to habitat availability in  
42 the Yolo Bypass would outweigh negative effects of increased exposures to water temperatures  
43 above the upper threshold of 75°F in the Feather River in drier water year types.

1 **Summary of CEQA Conclusion**

2 Overall, Alternative 1A would not affect splittail migration conditions in the Sacramento River  
3 relative to the Existing Conditions, the impact is not significant because it would not substantially  
4 reduce suitable migration habitat or substantially reduce the number of fish as a result of mortality  
5 and no mitigation is necessary. Similarly, Alternative 1A is expected to reduce OMR reverse flows  
6 during the period of juvenile splittail migration through the Delta, resulting in greatly improved  
7 conditions in June and July compared to baseline conditions across all water years. Therefore the  
8 impact on splittail migration survival is less than significant. No mitigation is required.

9 **Restoration Measures (CM2, CM4–CM7, and CM10)**

10 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

11 ***Temporary Increases in Turbidity***

12 Sacramento splittail inhabit naturally turbid water and forage more effectively in turbid water, and  
13 are unlikely to be affected by temporary increases in turbidity during restoration construction.  
14 Implementing the environmental commitments described under Impact AQUA-1 for delta smelt and  
15 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
16 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
17 *Prevention, Containment, and Countermeasure Plan; Fish Rescue and Salvage Plan; and Barge*  
18 *Operations Plan)*, would minimize the potential for turbidity to affect Sacramento splittail.

19 ***Increased Exposure to Methylmercury***

20 The potential effects of increased exposure to methylmercury on Sacramento splittail are expected  
21 to be similar to those discussed in detail for delta smelt under Impact AQUA-7, although the  
22 magnitude of effects would be different. Sacramento splittail spawning and rearing occur in restored  
23 shallow water floodplain habitat, where methylmercury concentrations would likely be greater than  
24 deeper open water habitat used extensively by delta smelt. As discussed above however, the overall  
25 effect of increased bioavailability of methylmercury on covered fish species is likely to be of low  
26 magnitude and localized. With implementation of *CM12 Methylmercury Management*, effects of  
27 methylmercury mobilization on Sacramento splittail at the tidal wetland restoration sites are  
28 expected to be minimized. In addition, the BMPs put in place to reduce turbidity will also minimize  
29 suspension of potentially contaminated sediments, although restoration activities will not produce  
30 the biogeochemical conditions that would support methylation of mercury; thus increased  
31 bioavailability and toxicity as a result of restoration construction activities are not expected.

32 ***Accidental Spills***

33 As discussed under Impact AQUA-1 and Impact AQUA-2, adverse effects from accidental spills will  
34 be avoided through implementation of appropriate impact avoidance and minimization  
35 measures(*Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
36 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
37 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge*  
38 *Operations Plan; see Appendix 3B, Environmental Commitments and Impact AQUA-1). Specifically,*  
39 *environmental commitment Spill Prevention, Containment, and Countermeasure Plan will be*  
40 *implemented to minimize the risk of spills occurring and to provide for rapid and effective response*

1 to contain any accidental spills. Pertinent details of these plans are provided under Impact AQUA-1  
2 for delta smelt. Therefore adverse effects from accidental spills would not be likely to occur.

### 3 ***Disturbance of Contaminated Sediments***

4 Runoff and resuspension of contaminants could cause short-term, localized increases in the  
5 concentrations of contaminants in and near restoration sites (see discussion for delta smelt under  
6 Impact AQUA-7). The potential impacts of toxics on Sacramento splittail would be minimized to the  
7 extent possible by timing construction activities so that vulnerable early life stages of fish are not  
8 present and implementation of environmental commitments (see Appendix 3B, *Environmental*  
9 *Commitments; Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
10 *Control Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge*  
11 *Operations Plan*). Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

### 12 ***In-Water Work Activities***

13 Restoration construction could temporarily produce noise levels and disturbances that could affect  
14 nearby Sacramento splittail. Such activities are not expected to elevate underwater noise above the  
15 threshold sound pressure levels established for fish protection(see discussion for delta smelt under  
16 Impact AQUA-1). Any changes in noise and light levels would be minor and temporary. In addition, it  
17 is likely that fish would avoid areas where shoreline activities increased noise and light. Potential  
18 effects of in-water activity would be minimized by implementation of the environmental  
19 commitments described under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments,*  
20 *including Erosion and Sediment Control Plan; Dispose of Spoils, Reusable Tunnel Material, and*  
21 *Dredged Material; and Barge Operations Plan.*

### 22 ***Predation***

23 Restoration construction would be unlikely to have any measurable effect on Sacramento splittail  
24 predation rates. Much of the restoration construction would occur on dry land (e.g., recontouring,  
25 removing levees) which would have no in-water effects including on predators. In-water activities  
26 may include the use of barges and other watercraft that could theoretically provide cover, shelter,  
27 and perching areas for predators. However, the limited duration of these activities and the  
28 associated noise and disturbance would be expected to dissuade predators from concentrating at  
29 sufficient density to measurably affect predation rates on Sacramento splittail.

### 30 ***Summary***

31 In-water and shoreline restoration activities would be scheduled to occur when the least numbers of  
32 Sacramento splittail would be present in or near the restoration sites. Such activities would include  
33 riprap removal and levee breaching, and shoreline excavation and re-contouring. In addition, runoff  
34 from upland construction areas would also have the potential to affect aquatic habitats and  
35 Sacramento splittail, although splittail are tolerant to increases in turbidity. Implementation of the  
36 environmental commitments described in Appendix 3B, *Environmental Commitments,* would  
37 minimize or eliminate effects on Sacramento splittail. These environmental commitments are  
38 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
39 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and*  
40 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material.* Pertinent details of these plans  
41 are provided under Impact AQUA-1 for delta smelt. As a result, the effects of short-term restoration  
42 construction activities are not adverse to Sacramento splittail.

1 As discussed for delta smelt (see Impact AQUA-7) implementation of these environmental  
2 commitments would minimize or eliminate short-term effects; however, more frequent inundation  
3 of these restored areas could promote conversion of mercury to methylated mercury and runoff  
4 containing agricultural-related toxins such as copper and organochlorine pesticides. The overall  
5 effect of increased bioavailability of methylmercury and other pollutants on Sacramento splittail is  
6 likely to be of low magnitude, periodic and localized. In addition, *CM12 Methylmercury Management*  
7 provides for site-specific assessment of restoration areas, integration of design measures to  
8 minimize methylmercury production.

9 **NEPA Effects:** Overall, the effects of habitat restoration are expected to be beneficial to Sacramento  
10 splittail by providing additional or improved habitat. As a result, the effects of short-term  
11 restoration activities are not adverse to Sacramento splittail.

12 **CEQA Conclusion:** Sacramento splittail inhabit naturally turbid water and are not expected to be  
13 affected by temporary increases in turbidity potentially occurring during restoration activities. In  
14 addition to in-water work window restrictions, the limited frequency, duration, and spatial extent of  
15 restoration construction activities would minimize potential effects on Sacramento splittail. For  
16 these reasons, and implementation of the environmental commitments described in detail under  
17 Impact AQUA-1 and in Appendix 3B, *Environmental Commitments (Environmental Training;*  
18 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
19 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
20 *Reusable Tunnel Material, and Dredged Material)*, impacts on Sacramento splittail from restoration  
21 construction activities would be less than significant because it would not substantially reduce its  
22 habitat, restrict its range or interfere with its movement. Consequently, no mitigation is required.

### 23 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on** 24 **Sacramento Splittail**

25 Effects of implementing the habitat restoration conservation measures (CM2, CM4–CM7, and CM10)  
26 on Sacramento splittail will depend on the life stage present in the area of elevated toxins and the  
27 duration of exposure. Release of toxic constituents from sediments (e.g., in restored areas) is tied to  
28 inundation, and so the highest concentrations will occur during seasonal high water and to a lesser  
29 extent for short time periods on a tidal cycle in marshes. As previously mentioned, a complete  
30 analysis can be found in the *BDCP Effects Analysis – Appendix D, Contaminants (hereby incorporated*  
31 *by reference)*. Potential impacts on Sacramento splittail from effects of methylmercury, selenium,  
32 copper, ammonia, and pesticides associated with habitat restoration activities would be similar to  
33 those discussed in detail for delta smelt (see Impact AQUA-8) except that Sacramento splittail is a  
34 benthic forager so the release of sediment borne contaminants may result in greater effects for this  
35 species. However, these effects are not expected to adversely affect Sacramento splittail. In addition,  
36 the overall effect of restoration measures is generally beneficial to Sacramento splittail.

37 The large numbers of factors that influence the production of methylmercury in freshwater tidal  
38 habitat make it challenging to predict methylmercury conditions, covered species exposures or  
39 bioaccumulation. The limited data available from past restoration actions indicate that  
40 methylmercury production in wetlands and resulting bioaccumulation is highly variable. It is  
41 reasonable to expect that some increases in methylmercury are possible on a local or regional scale.  
42 The Delta is currently impaired for methylmercury and a TMDL from the Central Valley Regional  
43 Water Quality Control Board is guiding loading reduction for both point and non-point sources to  
44 insure that the aquatic life associated beneficial uses are protected. The initial phase of the 2010

1 TMDL is underway and includes seven years of research on the management of methylmercury  
2 associated with Delta wetlands. Sacramento splittail is a benthic forager so released contaminants  
3 including mercury and selenium may be more problematic for this species.

4 Longer water residence times in restoration areas could make selenium more bioavailable to  
5 Sacramento splittail but Delta-relevant information is limited to assess this risk. Analysis of the  
6 effects of selenium bioaccumulation in fishes is located in Chapter 8 *Water Quality*. Areas of concern  
7 for splittail would include the western Delta and Suisun Bay, and the South Delta in areas that  
8 receive San Joaquin River water. In these locations, selenium load is bioaccumulated by invasive  
9 bivalves, increasing Sacramento splittail's exposure through their diet.

10 Portions of the San Joaquin River are on the 303(d) list and a TDML has been implemented to reduce  
11 loading. Because increases in bioavailable selenium in the habitat restoration areas are uncertain,  
12 proposed avoidance and minimization measures would require evaluating risks of selenium  
13 exposure at a project level for each restoration area, minimizing to the extent practicable potential  
14 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to  
15 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,  
16 *Environmental Commitments* for a description of the environmental commitment which are being  
17 made with respect to Selenium Management; and BDCP Appendix 3.C – *Avoidance and Minimization*  
18 *Measures, hereby incorporated by reference* for additional detail on this avoidance and minimization  
19 measure (AMM27).

20 **NEPA Effects:** It is anticipated that any potential effects of methylmercury and selenium on  
21 Sacramento splittail will be addressed through implementation of CM12 and AMM27. These  
22 measures are intended to minimize methylmercury and selenium exposure associated with  
23 restoration measures for Sacramento splittail at all life stages. Further analysis and tools may be  
24 developed to further reduce methylmercury and selenium exposure for Sacramento splittail as the  
25 habitat restoration conservation measures are refined and analyzed in site-specific documents. The  
26 site-specific analysis is the appropriate place to assess the potential for risk of methylmercury and  
27 selenium exposure for Sacramento splittail once site specific sampling and other information can be  
28 developed. Overall, the effects of contaminants associated with restoration measures would not be  
29 adverse for Sacramento splittail with respect to copper, ammonia and pesticides. The effects of  
30 methylmercury and selenium on Sacramento splittail are uncertain.

31 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
32 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
33 However, any such releases would be sporadic, short-term and localized, and would be unlikely to  
34 result in measurable increases in the bioaccumulation in Sacramento splittail even though it is a  
35 benthic forager. In addition, implementation of *CM12 Methylmercury Management* would help to  
36 minimize the increased mobilization of methylmercury at restoration areas. Therefore, the impact is  
37 considered less than significant because it would not substantially affect Sacramento splittail either  
38 directly or through habitat modifications. Consequently, no mitigation would be required.

### 39 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

40 The potential effects of the proposed conservation measures on Sacramento splittail are expected to  
41 be similar to those discussed under Impact AQUA-9 for delta smelt.

1 **CM2 Yolo Bypass Fisheries Enhancement**

2 As discussed under Impact AQUA-9, Yolo Bypass fisheries enhancement modifications are designed  
3 to increase the frequency, duration and magnitude of seasonal floodplain inundation in the Yolo  
4 Bypass. These actions would improve and enhance spawning and rearing habitat for Sacramento  
5 splittail. The Yolo Bypass is an important spawning area for splittail, and increasing the duration of  
6 inundation is expected to provide substantial benefits to splittail productivity in the Delta.

7 **CM4 Tidal Natural Communities Restoration**

8 Tidal wetland restoration adds substantially to the shallow water fish habitat in the Plan Area and in  
9 the five ROAs (see Impact AQUA-9). Expanded access to seasonal floodplain, tidal wetland, and  
10 improved channel margins will expand shallow water, low-velocity habitat with increased food  
11 production. Habitat Suitability Analysis indicates that tidal wetland restoration provides substantial  
12 increases in available habitat suitable for Sacramento splittail—as compared to Existing Conditions.  
13 A substantial extent of restored habitat in the Cache Slough and Suisun Marsh ROAs was modeled  
14 for Sacramento splittail, ranging from more than 4,000 HUs to nearly 6,500 HUs. Restored habitat  
15 size for splittail was appreciable in the South Delta ROA (more than 7,500 HUs for juveniles and  
16 5,000 HUs for adults). Splittail is not affected by the relatively warm temperature and low turbidity  
17 that limit the other species in the south Delta. For further discussion, see Impact AQUA-9.

18 **CM5 Seasonally Inundated Floodplain Restoration**

19 Under CM5, up to 10,000 acres of seasonally inundated floodplain would be restored, mainly in the  
20 south Delta, primarily through levee setbacks, removal of riprap, or grading of floodplain. Inundated  
21 vegetation on floodplains in the Central Valley is known to provide important spawning habitat for  
22 splittail adults and rearing habitat for juveniles. Therefore, enhancing and expanding such habitat  
23 would likely be beneficial to Sacramento splittail. For further discussion, see Impact AQUA-9.

24 **CM6 Channel Margin Enhancement**

25 Channel margin habitat is important for splittail during migration to and from upstream spawning  
26 habitats. Channel margin enhancement along such migration routes provides refuge from high flows  
27 and overhead and instream cover for protection from predators. Enhanced channel margins in the  
28 vicinity of the proposed north Delta intakes (upstream, between the intakes, and downstream)  
29 would provide resting spots and refuge for fish migrating through this area. Removal of bank  
30 protection is also expected to reestablish floodplain processes and create low-velocity, vegetated  
31 backwater habitats for Sacramento splittail spawning (see Impact AQUA-9). This habitat may be of  
32 particular importance in drier years when the availability of floodplain habitat is reduced.

33 **CM7 Riparian Natural Community Restoration**

34 For discussion of the effect on Sacramento splittail, see the discussion under Impact AQUA-9.

35 *CM7 Riparian Natural Community Restoration* is intended to restore riparian habitat within the  
36 context of flood control objectives and managed upstream hydrology, to provide direct and indirect  
37 benefits along migration corridors for aquatic, such as Sacramento splittail. Splittail also benefit  
38 from contributions of the riparian community to the aquatic foodweb, in the form of terrestrial  
39 insects and leaf litter that enter the water. Riparian vegetation also supports the formation of steep,  
40 undercut banks that provide cover for Sacramento splittail. The increased habitat complexity

1 provided by riparian restorations is expected to be beneficial to Sacramento splittail, which use low-  
2 velocity backwater habitats for spawning.

### 3 **CM10 Nontidal Marsh Restoration**

4 The potential types of effects of *CM10 Nontidal Marsh Restoration* would be similar to those  
5 discussed for delta smelt under Impact AQUA-9.

6 **NEPA Effects:** The types of effects of floodplain, tidal, channel margin and riparian habitat  
7 restoration activities on Sacramento splittail, are expected to be similar to those discussed for delta  
8 smelt (see Impact AQUA-9); additional rearing habitat will be provided in the Yolo Bypass. In  
9 general these effects are expected to be beneficial for Sacramento splittail, providing increased  
10 amounts and quality of available habitat, increasing habitat diversity and connectivity, increasing  
11 food and overall productivity and reducing predation.

12 Despite the improvements in habitat and habitat functions in the Delta from floodplain, tidal,  
13 channel margin and riparian habitat restoration activities, habitat quality is expected to decline in  
14 the LLT primarily because of climate change. Although these changes might result in a loss of  
15 individuals and a decline in habitat suitability, these may be offset by an increase in available habitat  
16 from restoration. The overall effect of restoration activities is expected to remain beneficial for  
17 Sacramento splittail.

18 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
19 management plan would be needed to determine an operational protocol that optimizes benefits  
20 both locally and in adjacent habitats.

21 **CEQA Conclusion:** As with delta smelt, the overall effects of floodplain, tidal, channel margin and  
22 riparian habitat restoration activities are expected to be beneficial for Sacramento splittail (see  
23 Impact AQUA-9). The general benefits include providing increased amounts and quality of available  
24 habitat, increasing habitat diversity, increasing overall productivity and reducing predation. Despite  
25 the improvements in habitat and habitat functions in the Delta from floodplain, tidal, channel  
26 margin, and riparian habitat restoration activities, habitat quality is expected to decline in the LLT  
27 primarily because of climate change. However, the overall impact of restoration activities is  
28 expected to remain beneficial for Sacramento splittail because they increase habitat. Consequently,  
29 **no** mitigation would be required.

### 30 **Other Conservation Measures (CM12–CM19 and CM21)**

#### 31 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

32 Refer to Impact AQUA-10 under delta smelt for a discussion of the potential effects of  
33 methylmercury management on Sacramento splittail except that Sacramento splittail is a benthic  
34 forager so any minimization of methylmercury amounts as the result of this conservation measure  
35 would likely be more beneficial for this species.

#### 36 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento 37 Splittail (CM13)**

38 Potential effects on Sacramento splittail from IAV control during operations are expected to be  
39 similar to those discussed for delta smelt (see Impact AQUA-11), which are expected to be  
40 somewhat beneficial.

1 Control of IAV would reduce habitat that supports predatory fish in freshwater nearshore habitat.  
2 Largemouth bass are strongly associated with dense IAV beds (Nobriga and Feyrer 2007; Conrad et  
3 al. 2010). A decrease in IAV in the Delta should open up nearshore habitats used by juvenile splittail  
4 for cover and rearing while reducing their encounters with piscivorous predators like largemouth  
5 bass. Dense IAV cover has also been associated with reduction of water turbidity in the Delta  
6 (Brown and Michniuk 2007). Removal of IAV may also provide increased turbidity, which is  
7 associated with reduced hunting success of visual predators like largemouth bass and striped bass  
8 (Gregory and Levings 1998).

9 **NEPA Effects:** The control of SAV is expected to reduce predation mortality, increase spawning and  
10 rearing habitat, and result in an increase in available food resources. Therefore, the overall effect of  
11 IAV removal and control is expected to be modestly beneficial to Sacramento splittail.

12 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to Sacramento splittail  
13 during operations through chemical and mechanical treatment and should reduce predation  
14 mortality, increase food availability and increase the amount of suitable spawning and rearing  
15 habitat. This impact is expected to be beneficial, consequently, no mitigation would be required.

16 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
17 **(CM14)**

18 **NEPA Effects:** As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very  
19 similar to Existing Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP  
20 export service areas (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14*  
21 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would increase the dissolved  
22 oxygen levels and improve aquatic habitat conditions for Sacramento splittail. The effect would be  
23 beneficial to Sacramento splittail.

24 **CEQA Conclusion:** As discussed in Chapter 8, *Water Quality*, *CM14 Stockton Deepwater Ship Channel*  
25 *Dissolved Oxygen Levels* management would increase the dissolved oxygen levels and improve  
26 aquatic habitat conditions. Sacramento splittail occur in the channel and the increased dissolved  
27 oxygen levels would improve habitat conditions for them, which would be a benefit. Consequently,  
28 no mitigation would be required.

29 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
30 **(CM15)**

31 **NEPA Effects:** Potential impacts on Sacramento splittail from predator removal at targeted local  
32 hotspots are expected to be similar to those for delta smelt (see Impact AQUA-13). Removing  
33 predators from localized hotspots, particularly at NPBs, is expected to slightly reduce the predation  
34 rates on Sacramento splittail. However, since the affected proportion of the population would be  
35 very small this effect would not be detectable.

36 **CEQA Conclusion:** Slightly reduced predation rates on Sacramento splittail from predator  
37 management would result in a slight benefit to the species. Since the affected proportion of the  
38 population would be very small, this expected benefit is would likely not be measurable.  
39 Consequently, no mitigation would be required.

1 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

2 The quantitative benefits of the installation of NPBs to Sacramento splittail are unknown and are  
3 described under Impact AQUA-14 for delta smelt. Considering species-specific factors such as water  
4 column position, hearing ability, and escape ability, NPBs at the entrances to CCF and the DMC have  
5 the most potential to considerably reduce entrainment of juvenile and adult Sacramento splittail,  
6 compared to other covered species.

7 Although NPBs are constructed and operated mainly with salmonids in mind, Sacramento splittail  
8 are likely to also be deterred by the NPBs based on their hearing ability and strong swimming ability  
9 as young juveniles. During wetter years, Sacramento splittail may migrate up the Sacramento and  
10 San Joaquin Rivers beyond the northern and southern boundaries of the Delta and therefore are  
11 likely to encounter the NPBs at head of Old River and Georgiana Slough. Although NPBs would likely  
12 be operated to coincide mainly with the juvenile salmonid emigration period, juvenile splittail  
13 outmigration to the Delta is most likely from April-August (Moyle 2002). Therefore, the first months  
14 of the juvenile Sacramento splittail migration to the Delta overlap with the main juvenile salmonid  
15 outmigration period. If NPBs are effective at deterring splittail away from areas with high mortality  
16 rates, such as Georgiana Slough, then the risks of predation for juvenile splittail would be reduced.

17 **NEPA Effects:** The NPBs also have the potential to attract predatory fish, which often hold around  
18 underwater human-made structure. Therefore, there is a slightly increased risk of predation for  
19 juvenile Sacramento splittail in the area immediately around the NPBs. However, the overall effects  
20 of NPBs would not be adverse.

21 **CEQA Conclusion:** Although NPBs are constructed and operated mainly with salmonids in mind,  
22 Sacramento splittail are likely to also be deterred by the NPBs based on their hearing ability and  
23 strong swimming ability as young juveniles. During wetter years, Sacramento splittail may migrate  
24 up the Sacramento and San Joaquin Rivers beyond the northern and southern boundaries of the  
25 Delta and therefore are likely to encounter the NPBs at head of Old River and Georgiana Slough.  
26 Although NPBs would likely be operated to coincide mainly with the juvenile salmonid emigration  
27 period, juvenile splittail outmigration to the Delta is most likely from April-August (Moyle 2002).  
28 Therefore, the first months of the juvenile Sacramento splittail migration to the Delta overlap with  
29 the main juvenile salmonid outmigration period. If NPBs are effective at deterring splittail away  
30 from areas with high mortality rates, such as Georgiana Slough, then the risks of predation for  
31 juvenile splittail would be reduced. The NPBs also have the potential to attract predatory fish, which  
32 often hold around underwater human-made structure. Therefore, there is a slightly increased risk of  
33 predation for juvenile Sacramento splittail in the area immediately around the NPBs. However the  
34 overall impacts of the NPBs are expected to be less than significant on Sacramento splittail because  
35 they would reduce entrainment which would potentially increase their numbers. Consequently, no  
36 mitigation would be required.

37 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

38 **NEPA Effects:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley  
39 steelhead, green sturgeon and white sturgeon and are expected to have positive effects on their  
40 populations. Since this conservation measure is not applied to Sacramento splittail it would have no  
41 direct effect on them. Therefore, the effect would not be adverse.

42 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
43 Valley steelhead, green sturgeon and white sturgeon and are expected to have positive effects on

1 their populations. Since this conservation measure is not applied to Sacramento splittail it would  
2 have no direct effect on them. Consequently, no mitigation would be required.

### 3 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

4 **NEPA Effects:** *CM18 Conservation Hatcheries* would establish new and expand existing  
5 conservation propagation programs for delta and longfin smelt. This conservation measure would  
6 have no effect on Sacramento splittail.

7 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing  
8 conservation propagation programs for delta and longfin smelt. This conservation measure would  
9 have no impact on Sacramento splittail. Consequently, no mitigation would be required.

### 10 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

11 **NEPA Effects:** The effects of urban stormwater treatment (CM19) would reduce contaminants  
12 associated with urban areas because it provides for the treatment of stormwater discharges. As  
13 discussed in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled  
14 *Pyrethroids, Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment  
15 would reduce urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and  
16 other contaminants. These reductions would contribute to improved water quality in the Delta.  
17 Sacramento splittail are benthic feeders, so any reductions in sediment borne contaminants would  
18 be particularly beneficial. Based on the improved overall water quality conditions and reduced  
19 pesticides the effect could be beneficial.

20 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
21 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
22 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
23 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
24 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
25 contaminants. These reductions would contribute to improved water quality in the Delta.  
26 Sacramento splittail are benthic feeders. Therefore, the impacts of urban stormwater treatment  
27 would be beneficial because it would have a beneficial effect both directly and through habitat  
28 modifications on Sacramento splittail. Consequently, no mitigation would be required.

### 29 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento** 30 **Splittail (CM21)**

31 **NEPA Effects:** There is no evidence of substantial entrainment of covered fish species at agricultural  
32 diversions in the Plan Area, but some entrainment likely is occurring. Whatever entrainment is  
33 occurring would be reduced by decommissioning agricultural diversions in the ROAs. PTM runs and  
34 extrapolations to a hypothetical number of diversions to be removed from the ROAs (i.e.,  
35 approximately 4–12% of diversions) estimated slight reductions in entrainment for delta smelt and  
36 longfin smelt. While the amount of reduced entrainment for Sacramento splittail might be lower, the  
37 effects would be beneficial.

38 **CEQA Conclusion:** There is no evidence of substantial entrainment of covered fish species at  
39 agricultural diversions in the Plan Area, but some entrainment likely is occurring. Whatever  
40 entrainment is occurring would be reduced by decommissioning agricultural diversions in the ROAs.  
41 PTM runs and extrapolations to a hypothetical number of diversions to be removed from the ROAs

1 (i.e., approximately 4–12% of diversions) estimated slight reductions in entrainment for delta smelt  
2 and longfin smelt. While the amount of reduced entrainment for Sacramento splittail might be  
3 lower, the impacts would be beneficial because it would reduce entrainment which could have a  
4 positive impact on Sacramento splittail numbers. Consequently, no mitigation would be required.

## 5 **Green Sturgeon**

### 6 **Construction**

#### 7 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

8 Juvenile green sturgeon are present year-round and could be present during construction of both  
9 intakes and barge landings (see Table 11-4). Juvenile sturgeon can rear for up to 3 years in  
10 freshwater before migrating to the ocean. In the north Delta and east Delta, adult sturgeon could be  
11 present any time of the year although peak occurrence is primarily in April through June, with  
12 moderate numbers between September and March. In the south Delta, green sturgeon adults are  
13 present year-round. The potential for exposure of green sturgeon to construction-related activities  
14 is expected to be low to moderate. In addition, adherence to the expected in-water work window  
15 (June through October) would help to minimize, but would not eliminate, construction effects on  
16 green sturgeon.

#### 17 ***Temporary Increases in Turbidity***

18 Because green sturgeon are benthic fish, they inhabit naturally turbid water. They are unlikely to be  
19 affected by a temporary increase in turbidity. As discussed for delta smelt (see Impact AQUA-1),  
20 environmental commitments would be implemented to reduce turbidity during construction  
21 activities (see Appendix 3B, *Environmental Commitments: Environmental Training; Stormwater  
22 Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management  
23 Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel  
24 Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan*). Pertinent  
25 details of these plans are provided under Impact AQUA-1 for delta smelt.

#### 26 ***Accidental Spills***

27 Potential impacts on green sturgeon from accidental spills during construction are similar to those  
28 discussed for delta smelt (see Impact AQUA-1). These impacts would be minimized by implementing  
29 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
30 *Environmental Commitments. (Environmental Training; Stormwater Pollution Prevention Plan;  
31 Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,  
32 Containment, and Countermeasure Plan)*. Specifically, the *Spill Prevention, Containment, and  
33 Countermeasure Plan* would be expected to minimize the potential for introduction of contaminants  
34 to surface waters and provide for effective containment and cleanup should accidental spills occur.  
35 Pertinent details of these plans are discussed under Impact AQUA-1 for delta smelt.

#### 36 ***Disturbance of Contaminated Sediments***

37 There is a potential risk of contaminated sediments affecting green sturgeon during construction of  
38 intakes and barge landings if they are present in the vicinity of in-water construction activities (see  
39 Impact AQUA-1 for delta smelt). These risks can include reduced reproduction and growth rates, as  
40 well as potentially higher mortality rates, particularly for larval and juvenile life stages (Silvestre, et

1 al. 2010; Lee et al. 2011). Because green sturgeon are mainly benthic dwellers, they may be more  
2 susceptible to contaminants than other fish species. However, the suspension of sediments would be  
3 minimized by implementation of environmental commitments described under Impact AQUA-1 for  
4 delta smelt and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater*  
5 *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*  
6 *Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel*  
7 *Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan)*. Pertinent  
8 details of these plans are provided under Impact AQUA-1 for delta smelt.

### 9 ***Underwater Noise***

10 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
11 green sturgeon. It is important to note that this impact would be realized only where piles must be  
12 impact driven; underwater sound generated by vibratory pile installation methods are not  
13 sufficiently loud to injure fish.

14 Green sturgeon larvae could experience underwater sound effects, should they occur in the locations  
15 of the intakes and barge landings during the in-water construction period, and would be affected by  
16 underwater noise levels that exceed injury or disturbance thresholds (see Impact AQUA-1). Juvenile  
17 and adult green sturgeon could be present near the intakes during June through October, when pile  
18 driving would occur, as they migrate to and from upstream spawning areas. Adult green sturgeon  
19 are large and less susceptible to noise from impact driving, and might be able to avoid injurious  
20 exposure to underwater noise from pile driving. They may experience short delays in migration past  
21 the intakes when pile driving occurs; however, pile driving would occur only intermittently through  
22 a portion of the day, and minor migration delays would not affect their ability to successfully reach  
23 spawning grounds. Therefore, the potential for adult green sturgeon to experience an adverse effect  
24 (e.g., injury or mortality, or substantial migratory disturbance) from impact pile driving would likely  
25 be low-to-moderate because of their size, ability to move away from the underwater sound, and  
26 their potentially low temporal and spatial distribution during construction areas. Furthermore,  
27 potential exposure of green sturgeon to underwater sound above the threshold criterion would be  
28 typically be intermittent and limited.

29 Juvenile green sturgeon would have a relatively low abundance near the intakes and barge landings  
30 throughout the June through October pile driving period. Given these numbers in the east and south  
31 Delta areas; the relatively small areas affected by underwater noise in these areas; and the  
32 intermittent nature of potential exposure to underwater sound above the threshold, there is a low  
33 chance that juvenile green sturgeon would be exposed to noise levels from impact pile driving at the  
34 barge landing sites. However, a greater number of juveniles could be present in the north Delta  
35 during construction of the intake cofferdams, resulting in a moderate risk of exposure to potentially  
36 harmful underwater sound levels. Therefore, there is a moderate potential for juvenile green  
37 sturgeon to experience an adverse effect (e.g., injury or mortality).

38 If an individual juvenile green sturgeon (less than 2 grams in size) were present in an area affected  
39 by underwater sound from impact pile driving above the effects threshold of 183-dB SEL<sub>cumulative</sub>,  
40 and proximate to an impact-driven pile, it could experience an adverse effect, such as injury or  
41 mortality. However, because of the overall low-to-moderate densities of juvenile green sturgeon  
42 expected in all pile driving locations, the limited area subject to underwater sound exceeding the  
43 effects threshold, and implementation of the avoidance and minimization measures included in

1 Mitigation Measures AQUA-1a and AQUA-1b, the potential for juvenile green sturgeon to experience  
2 an adverse effect from impact pile driving (e.g., injury or mortality) would be low.

### 3 ***Fish Stranding***

4 Green sturgeon trapped within cofferdams or other fish exclusion structures would be at some risk  
5 for injury during fish removal activities. Because adults and juvenile green sturgeon could be  
6 present at any time during the year, some low risk of impact exists. Fish removal activities from  
7 construction areas would be implemented according to environmental commitment *Fish Rescue and*  
8 *Salvage Plan*, as described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
9 *Commitments*). Pertinent details of this plan are discussed under Impact AQUA-1 for delta smelt.  
10 Because of these measures, the risk of substantial effects would be minimized.

### 11 ***In-Water Work Activities***

12 As discussed for delta smelt (see Impact AQUA-1), in-water work activities have the potential  
13 disturb, injure or kill fish through direct physical injury from construction activities. Although fish  
14 would likely avoid the noise and activity of pile installation and placement of riprap protection,  
15 these activities have the potential to affect fish. Primarily juvenile green sturgeon would be expected  
16 in the vicinity of the intake facilities and barge landings during construction. Because of the  
17 relatively low densities of juvenile green sturgeon expected in all construction areas, the potential  
18 for effects would be limited. Potential effects would also be minimized by implementation of  
19 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
20 *Environmental Commitments*, including *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable*  
21 *Tunnel Material, and Dredged Material; and Barge Operations Plan*.

### 22 ***Loss of Spawning, Rearing, or Migration Habitat***

23 There is no suitable spawning habitat for green sturgeon in the vicinity of the proposed in-water  
24 work; therefore, green sturgeon spawning habitat would not be affected by construction activities.  
25 However, construction would temporarily and permanently affect migration and rearing habitat.  
26 Any activity that occurs in a species migration corridor has the potential to affect the behavior (i.e.,  
27 through a change in migration route within the channel, delay from a noise deterrent, artificial light  
28 sources, etc.). However, effects on migration habitat would be limited because much of the  
29 construction would be confined within the cofferdams, and would not obstruct the remainder of the  
30 river channel, which would be of the same quality as in the construction area. The existing migration  
31 and rearing habitat is of relatively low quality, due to the armored levees with limited riparian  
32 vegetation. Therefore, the overall effects would be limited.

33 Implementation of *CM6 Channel Margin Enhancement* would enhance channel margin habitat along  
34 20 miles of the Sacramento River, including the vicinity of the intake structures, and would be  
35 designed to result in a net improvement in channel margin habitat function. Implementation of  
36 environmental commitment *Barge Operations Plan* (see Impact AQUA-1 for delta smelt and  
37 Appendix 3B, *Environmental Commitments*) would limit the potential for impacts from vessel wakes  
38 and propeller wash on shoreline habitat.

39 Construction of the intakes and barge landings will temporarily affect green sturgeon migration and  
40 rearing habitat, and the intakes screens will permanently alter the nearshore portion of this habitat  
41 in the Sacramento River. Because of implementation of *CM6 Channel Margin Enhancement* the

1 overall effects would be limited because of the relatively poor quality of the current habitat, and the  
2 addition of new, higher quality habitat associated with *CM6 Channel Margin Enhancement*.

### 3 **Predation**

4 Construction of in-water pilings and over-water structures and local temporary increases in  
5 turbidity associated with construction may affect predation on various fish species, including green  
6 sturgeon. In a laboratory study, prickly sculpin and northern pikeminnow have been observed to  
7 consume juvenile sturgeon (Gadomski and Parsley 2005), and some degree of predation occurs.  
8 However, due to the armored scutes (bony external scale)(French et al. 2010) and relatively rapid  
9 growth of sturgeon, predation would likely be low following the early life stages. Nobriga and Feyrer  
10 (2008) examined data for striped bass stomach contents collected between 1963 and 2003, and did  
11 not find any sturgeon among the more than 4,000 samples. The increase in cover habitat for bass  
12 and other predatory fish that would be created at the barge landings would likely result in only a  
13 minimal effect on green sturgeon.

### 14 **Summary**

15 In-water construction activities would be scheduled to occur when a limited number of green  
16 sturgeon would likely to be present in or near the construction areas, although some sturgeon are  
17 expected to occur in river and Delta throughout the in-water construction period. Potential effects of  
18 construction activities relate to turbidity, accidental spills, onsite and offsite sediment transport to  
19 surface waters, and re-suspension and redistribution of potentially contaminated sediments. Along  
20 with the species' tolerance to turbidity, implementation of environmental  
21 commitments (*Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment  
22 Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and  
23 Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish  
24 Rescue and Salvage Plan; and Barge Operations Plan* described under Impact AQUA-1 for delta smelt  
25 and Appendix 3B, *Environmental Commitments*) would minimize the effects of these construction  
26 activities. The limited number of green sturgeon that could be present during the expected in-water  
27 work window would also reduce the potential for green sturgeon to be injured or killed as a result of  
28 in-water construction activities. Therefore, these effects would not be adverse to green sturgeon.

29 Impact pile driving could result in significant impacts on individual green sturgeon because they  
30 could be exposed to sound levels exceeding the interim SEL<sub>cumulative</sub> threshold. However, the  
31 numbers of fish affected by this level of noise would be relatively small, pile driving would be limited  
32 to periods of relatively low fish abundance, and vibratory methods would be used whenever  
33 possible (to avoid the noise associated with impact pile driving). Implementation of Mitigation  
34 Measures AQUA-1a and AQUA-1b would reduce the occurrence, or severity, of these potential  
35 effects. Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge  
36 Operations Plan* (as described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
37 *Environmental Commitments*) would also reduce potential effects of construction activities on green  
38 sturgeon. Accordingly, underwater noise from impact pile driving would not result in adverse effects  
39 on green sturgeon.

40 Construction of the approach canal and Byron Tract Forebay would not affect fish-accessible  
41 waterways and therefore would not affect green sturgeon. As a result, these construction activities  
42 would not result in adverse effects on green sturgeon.

1 The effect of temporary and permanent rearing and migration habitat loss for green sturgeon would  
2 not be adverse due to the relatively small areas occupied by the construction and barge landing  
3 sites, the relatively low abundance of green sturgeon expected in the vicinity of these facilities  
4 during construction, and the low quality of the habitat affected by construction, as well as  
5 implementation of the environmental commitment *Barge Operations Plan* (see Impact AQUA-1 for  
6 delta smelt and Appendix 3B, *Environmental Commitments*). Overall, the potential effects of  
7 construction activities on migration and rearing habitat are not expected to adversely affect green  
8 sturgeon.

9 Locally increased predator habitat and predation from the temporary construction structures  
10 (cofferdams and barge landing docks) would not have population level effects. Therefore, predation  
11 effects on green sturgeon from construction activities would not be adverse.

12 **NEPA Effects:** The effects would not be adverse for green sturgeon.

13 **CEQA Conclusion:** As discussed above, in-water construction activities would be scheduled to occur  
14 when the least number of green sturgeon would likely be present in or near the construction areas.  
15 Implementation of environmental commitments *Environmental Training; Stormwater Pollution*  
16 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
17 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
18 *and Dredged Material* (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental*  
19 *Commitments*)—as well as the species' tolerance to turbidity—would minimize the effects of  
20 construction activities on turbidity, accidental spills, onsite and offsite sediment transport to surface  
21 waters, and re-suspension and redistribution of potentially contaminated sediments. As a result,  
22 these impacts would be less than significant to green sturgeon.

23 Although only a limited occurrence of green sturgeon is expected in the construction areas the direct  
24 effects of underwater construction noise on them would be a significant impact because of the high  
25 likelihood that it would cause injury or death to most impacted fish in the immediate vicinity of the  
26 activity. However, Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for  
27 effects from underwater noise and would reduce the severity of impacts to a less-than-significant  
28 level. Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge*  
29 *Operations Plan* (as described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
30 *Environmental Commitments*) would also minimize potential impacts of construction activities on  
31 green sturgeon.

32 The limited susceptibility of sturgeon to predation and the locally increased predator habitat and  
33 predation from the temporary construction structures (cofferdams and barge landing docks) would  
34 not have population level effects. The effect of temporary and permanent rearing and migration  
35 habitat loss for green sturgeon would be limited due to the relatively small areas occupied by the  
36 construction and barge landing sites, and the low quality of the habitat affected by construction, as  
37 well as implementation of the environmental commitment *Barge Operations Plan* (see Impact AQUA-  
38 1 for delta smelt and Appendix 3B). Implementation of *CM6 Channel Margin Enhancement* would  
39 also result in a net improvement in channel margin habitat function. Overall, the potential impacts of  
40 construction activities are expected to be less than significant. No additional mitigation would be  
41 required.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

7           **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

8           ***Temporary Increases in Turbidity***

9           As discussed for construction-related effects on turbidity (Impact AQUA-127), the potential  
10          increases in turbidity would be minimized to the extent possible through implementing the  
11          environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
12          *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
13          *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
14          *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
15          *Material; Fish Rescue and Salvage Plan; and Barge Operations Plan).*

16          ***Accidental Spills***

17          Maintenance activities such as dredging, levee repair and placement of riprap could accidentally  
18          introduce contaminants into the aquatic environment. However, implementation of the  
19          environmental commitments described under Impact AQUA-1 and in Appendix 3B, *Environmental*  
20          *Commitments*, would reduce the likelihood of any significant contaminant input to the Sacramento  
21          River and potential effects on green sturgeon survival. These environmental commitments are  
22          *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
23          *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;*  
24          *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*

25          ***Underwater Noise***

26          As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
27          maintenance activities are not expected to reach a level that would harm juvenile or adult fishes.  
28          NMFS has found that underwater sound pressure levels less than the 150 dB RMS behavioral effects  
29          threshold may result in temporary altered behavior of fishes indicative of stress but would not  
30          result in permanent harm or injury (National Marine Fisheries Service 2001). Any increases in  
31          underwater noise would be temporary and infrequent, and would occur when the least number of  
32          green sturgeon are likely to be present.

33          ***Maintenance-Related Disturbance***

34          Direct injury and mortality of green sturgeon from the use of in-water equipment during  
35          maintenance are most likely to occur during dredging activities around the new intakes. Suction  
36          dredging and mechanical excavation can capture or crush fish, causing injury or mortality. Green  
37          sturgeon are present year-round in the Sacramento River. Because sturgeon are benthic feeders,  
38          they may become entrained or injured by the dredge. However, potential effects would be  
39          minimized because maintenance dredging would occur infrequently, for a short duration, and in

1 limited areas. Furthermore, effects would be minimized by implementation of environmental  
2 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
3 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
4 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
5 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
6 *and Salvage Plan; and Barge Operations Plan).*

#### 7 ***Loss of Spawning, Rearing, or Migration Habitat***

8 Green sturgeon habitat near the intake structures is limited to rearing and migration. A small area of  
9 rearing habitat (i.e., 600 m<sup>2</sup>) could be affected due to maintenance dredging. Dredging would  
10 remove benthic macroinvertebrates that are consumed by green sturgeon. Migration habitat would  
11 be available farther out in the channel and would be unaffected by dredging or riprap placement.  
12 Rearing and migration habitat of similar quantity and quality would also be readily accessible to  
13 green sturgeon in the immediate area. Effects would be minimized by implementation of  
14 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
15 *Environmental Commitments*, including *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable*  
16 *Tunnel Material, and Dredged Material; and Barge Operations Plan.*

#### 17 ***Predation***

18 Maintenance activities would be unlikely to have any measurable effect on green sturgeon predation  
19 rates. These activities may include the use of barges and other watercraft that could theoretically  
20 provide cover, shelter, and perching areas for delta smelt predators. However, the limited duration  
21 of maintenance activities and the associated noise and disturbance would be expected to dissuade  
22 predators from concentrating at sufficient density to measurably affect predation rates on green  
23 sturgeon. Additionally, due to the armored scutes (bony external scale) and relatively rapid growth  
24 of sturgeon, predation might be lower compared to other covered fish species following the early life  
25 stages (French et al. 2010).

#### 26 ***Summary***

27 In-water activities would be scheduled to occur when the least number of green sturgeon could be  
28 present in or near the maintenance areas. In addition, green sturgeon are tolerant to increases in  
29 turbidity, which might occur during maintenance activities. Such activities would include  
30 maintenance dredging at the intake sites, and installation or repair of riprap bank armoring.  
31 Implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
32 and in Appendix 3B, *Environmental Commitments*, would further minimize or eliminate effects on  
33 green sturgeon by reducing the amount of turbidity and guiding the rapid and effective response in  
34 the case of inadvertent spills of hazardous materials. These environmental commitments include  
35 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
36 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and*  
37 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material.*

38 Implementation of these environmental commitments, along with low numbers of green sturgeon  
39 expected to occur in the maintenance areas during the expected in-water work windows, and the  
40 limited frequency and duration of in-water maintenance activities would result in a very low  
41 potential for adverse effects on green sturgeon. In addition, no spawning habitat occurs in the areas  
42 potentially affected by maintenance activities, and ample rearing, and migration habitat of the same

1 quality is readily accessible in the area, and this habitat would not be affected by maintenance  
2 activities.

3 **NEPA Effects:** As a result, the effects of short-term maintenance activities would not be adverse to  
4 green sturgeon.

5 **CEQA Conclusion:** Green sturgeon are benthic fish that inhabit naturally turbid water and are not  
6 expected to be affected by temporary increases in turbidity during maintenance activities. In  
7 addition to the limited frequency and duration of in-water maintenance activities and  
8 implementation of the commitments identified above and described in detail under Impact AQUA-1  
9 for delta smelt and in Appendix 3B, *Environmental Commitments*, would minimize the potential for  
10 maintenance activities to affect green sturgeon by reducing the amount of turbidity and guiding the  
11 rapid and effective response to inadvertent spills of hazardous materials. These environmental  
12 commitments include *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and*  
13 *Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
14 *Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material.*  
15 Potential changes to habitat would also be limited and temporary.

16 In addition to being benthic dwellers, green sturgeon are present year-round in the Sacramento  
17 River, so they could potentially become entrained or injured by dredging equipment. Although the  
18 number of green sturgeon that could be affected by dredging is unknown, but expected to be low.  
19 Because maintenance dredging would occur infrequently, for a short duration, and in limited areas,  
20 in-water maintenance activities would not affect green sturgeon.

21 Green sturgeon habitat near the intake structures is limited to rearing and migration, and similar  
22 habitat occurs in adjacent areas. Therefore, the limited extent of habitat disturbance expected from  
23 periodic maintenance activities is not expected to substantially decrease the available rearing and  
24 migration habitat in the area. Overall, the potential impact of maintenance activities is considered  
25 less than significant because it would not substantially reduce green sturgeon habitat, restrict its  
26 range, or interfere with its movement. Consequently, no mitigation would be required.

## 27 **Water Operations of CM1**

### 28 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

#### 29 ***Water Exports from SWP/CVP South Delta Facilities***

30 Alternative 1A would result in an overall annual average reduction in salvage of juvenile green  
31 sturgeon at the SWP/CVP south Delta facilities of approximately 56% to 60% (60–70 fish) compared  
32 to baseline scenarios.

33 Total annual average salvage of juvenile green sturgeon at the SWP south delta facilities was  
34 estimated at approximately 70 fish under all baseline scenarios and 18 fish under the two  
35 Alternative 1A scenarios. Differences between baseline and Alternative 1A were less at the CVP,  
36 where baseline scenario salvage ranged from 37 to 45 green sturgeon and the Alternative 1A  
37 scenario salvage was approximately 18 green sturgeon.

38 Reductions in salvage under Alternative 1A scenarios compared to baseline scenarios ranged from  
39 very little change in March–June (0–3 fewer fish per month) to considerable changes in February  
40 (approximately 25 fewer green sturgeon, or a 95% reduction) and in August–September (7–15  
41 fewer fish, or a 33–65% reduction). The Juvenile Green Sturgeon Entrainment Index (Number of

1 Fish as Expanded Salvage  $\pm$  95% Confidence Intervals) was estimated at the CVP during  
2 wet and above-normal years. Salvage is estimated to peak in October and November at the CVP  
3 under all model scenarios. Total annual average salvage of juvenile green sturgeon at the SWP was  
4 estimated at approximately 12–14 fish under all baseline scenarios and 13 fish under the two  
5 Alternative 1A scenarios. At the CVP, baseline scenario total annual salvage ranged from 29 to 36  
6 green sturgeon, and Alternative 1A scenario salvage was 25–30 green sturgeon.

7 Reductions in salvage at both facilities combined under Alternative 1A scenarios compared to  
8 baseline scenarios were low throughout the year (fewer than 10 green sturgeon per month, with no  
9 measurable differences in many months). The overall annual average decrease in salvage under  
10 Alternative 1A scenarios compared to baseline scenarios ranged from three to 12 green sturgeon  
11 (7–25% reductions).

12 Under the assumption that reduced export pumping in the south Delta is directly proportional to  
13 entrainment of juvenile green sturgeon, entrainment is expected to decrease under Alternative 1A  
14 relative to NAA. The decrease would be greater in wet and above-normal years (40–60%) than in  
15 below-normal, dry, and critical years (10–30% or less).

#### 16 ***Water Exports from SWP/CVP North Delta Intake Facilities***

17 Potential entrainment at the north Delta intakes occurs only under the action alternatives, including  
18 Alternative 1A, because there are no north Delta intakes operational under NAA. The north Delta  
19 intakes would be screened, which will be designed and built to specifications that are developed to  
20 reduce the entrainment and impingement of covered fish species. They are expected to exclude  
21 juvenile fish less than about 15 mm long, which is smaller than most life stages of all the covered  
22 fish, the screens are expected to be protective of nearly all life stages of all covered fish species (as  
23 evaluated in *BDCP Effects Analysis – Appendix 5B, Entrainment, Section B.5.9.2.1 Screening*  
24 *Effectiveness Analysis, hereby incorporated by reference*). Exceptions could be smaller larvae of delta  
25 smelt, Sacramento splittail, and sturgeon that may occur in the intake vicinity. Very little is known of  
26 the densities of these species in this area, so entrainment and impingement monitoring will  
27 determine the extent to which they are present. The project’s adaptive management plan includes  
28 monitoring of the new screens to determine their effectiveness and if they are not meeting  
29 expectations additional measures may be implemented to improve screen performance. These  
30 measures may include modifications to the screens or other structural components at the intakes, or  
31 changes in water diversion operations to reduce entrainment or impingement rates of juvenile  
32 green sturgeon.

#### 33 ***Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct***

34 Entrainment of green sturgeon at the North Bay Aqueduct has not been explicitly analyzed.  
35 However, the Barker Slough Pumping Plant is screened for fish >25mm and the alternative intake  
36 would presumably have screens of 1.75-m mesh and therefore it would exclude green sturgeon  
37 >10mm based on north Delta intake analysis. Overall effects would be expected to be no greater  
38 than for delta smelt.

39 If unforeseen changes in distributions or other factors occur as a result of project operations that  
40 would increase proportional loss of green sturgeon to entrainment, monitoring and the BDCP-  
41 proposed Real-Time Response Team would implement measures to avoid or minimize any potential  
42 threats to the species that might occur. Based on the current analysis, this would not be necessary.

1 **Predation Associated with Entrainment**

2 Predation can occur in association with the various intakes. The proportion of juvenile sturgeon lost  
3 to predation after entrainment, especially in CCF, is also unknown but should not be altered under  
4 CM1. Increased presence of predators around the north Delta intakes may increase predation loss of  
5 juveniles emigrating downstream to rear in the Delta. Juvenile sturgeon begin to emigrate at a small  
6 size and may be small enough to still be preyed upon by piscivorous fish as they pass by the north  
7 Delta facilities, although they do grow very rapidly early in their development.

8 **NEPA Effects:** Based on the projected entrainment of green sturgeon under the BDCP, a slight  
9 reduction of entrainment is expected at the south Delta facilities. However, the potential  
10 entrainment of larval sturgeon at the north Delta facility raises some uncertainty of the overall  
11 change in entrainment rate. This uncertainty will be addressed through monitoring and adaptive  
12 management actions. Based on available information, overall entrainment effects on green sturgeon  
13 are not expected to substantially change under Alternative 1A. Consequently, the effect would not be  
14 adverse.

15 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
16 south SWP/CVP facilities are expected to result in a slight decrease in entrainment of green  
17 sturgeon. However, operational activities associated with water exports from SWP/CVP north Delta  
18 intake facilities could result in an increase in entrainment or a loss of individual sturgeon at that  
19 location. However, monitoring and adaptive management protocols will be implemented to confirm  
20 that fish are being excluded from entrainment and impingement in the manner that the design  
21 specifications suggest and which are consistent with biological objectives. Overall, impacts of water  
22 operations on entrainment of green sturgeon would be less than significant because they would not  
23 reduce their numbers. Consequently, no mitigation would be required.

24 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
25 **Green Sturgeon**

26 In general, Alternative 1A would not affect spawning and egg incubation habitat for green sturgeon  
27 relative to NAA.

28 **Sacramento River**

29 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
30 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows  
31 can reduce the instream area available for spawning and egg incubation. Flows under A1A\_LLT  
32 would always be similar to or greater (up to 17%) than flows under NAA throughout the period at  
33 both locations although flows can be lower or higher in individual months of individual years  
34 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
36 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
37 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
38 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
39 NAA and Alternative 1A in any month or water year type throughout the period.

1 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was  
 2 determined for each month (May through September) and year of the 82-year modeling period  
 3 (Table 11-1A-11). The combination of number of days and degrees above the 63°F threshold were  
 4 further assigned a “level of concern”, as defined in Table 11-1A-12. Differences between baselines  
 5 and Alternative 1A in the highest level of concern across all months and all 82 modeled years are  
 6 presented in Table 11-1A-62. There would be no difference in levels of concern between NAA and  
 7 Alternative 1A.

8 **Table 11-1A-62. Differences between Baseline and Alternative 1A Scenarios in the Number of**  
 9 **Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern,**  
 10 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
Red	10 (250%)	1 (7%)
Orange	1 (100%)	1 (50%)
Yellow	3 (150%)	0 (0%)
None	-14 (-19%)	-2 (-3%)

11  
 12 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type  
 13 during May through September (Table 11-1A-63). Total degree-days under Alternative 1A would be  
 14 5% and 50% lower than under NAA during May and June, respectively, and 5% to 6% higher during  
 15 July through September.

1 **Table 11-1A-63. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the**  
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
May	Wet	51 (392%)	-4 (-6%)
	Above Normal	0 (NA)	-5 (-100%)
	Below Normal	4 (NA)	2 (100%)
	Dry	0 (NA)	0 (NA)
	Critical	4 (NA)	3 (300%)
	All	59 (454%)	-4 (-5%)
June	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	2 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	7 (NA)	-11 (-61%)
	All	9 (NA)	-9 (-50%)
July	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	1 (NA)
	Dry	6 (NA)	6 (NA)
	Critical	660 (8,250%)	30 (4.7%)
	All	667 (8,338%)	37 (6%)
August	Wet	2 (NA)	-1 (-33%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	3 (NA)	3 (NA)
	Dry	118 (NA)	52 (79%)
	Critical	1,618 (805%)	57 (3%)
	All	1,741 (866%)	111 (6%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	17 (NA)	15 (750%)
	Below Normal	77 (NA)	64 (492%)
	Dry	512 (1,652%)	29 (6%)
	Critical	1,267 (475%)	5 (0%)
	All	1,873 (629%)	113 (5%)

NA = could not be calculated because the denominator was 0.

4

5 ***Feather River***

6 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with  
 7 the Sacramento River during the February through June spawning and egg incubation period for  
 8 green sturgeon. At Thermalito Afterbay, flows under A1A\_LLT would be greater by up to 138% than  
 9 flows under NAA throughout the period depending on month and water year type. (Appendix 11C,  
 10 *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence, flows under Alternative 1A  
 11 would generally be similar to or up to 44% greater than flows under NAA depending on month and  
 12 water year type, except during April through June in the ELT and during March in the LLT.

1 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
 2 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
 3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 5 NAA and Alternative 1A in any month or water year type throughout the period.

6 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
 7 was evaluated during May through September (Table 11-1A-64). For this impact, only the months of  
 8 May and June were examined because spawning and egg incubation does not generally extend  
 9 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In  
 10 both May and June, the percent of months exceeding the threshold under Alternative 1A would be  
 11 similar to or lower (up to 21% lower on an absolute scale) than the percent under NAA.

12 **Table 11-1A-64. Differences between Baseline and Alternative 1A Scenarios in Percent of Months**  
 13 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 14 **River at Gridley Exceed the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A1A_LL1</b>					
May	23 (73%)	17 (93%)	11 (113%)	10 (267%)	7 (300%)
June	1 (1%)	1 (1%)	9 (11%)	10 (15%)	21 (44%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	26 (38%)
August	0 (0%)	0 (0%)	6 (7%)	16 (20%)	32 (52%)
September	27 (39%)	33 (61%)	47 (165%)	53 (717%)	38 (1,550%)
<b>NAA vs. A1A_LL1</b>					
May	-16 (-22%)	-21 (-37%)	-11 (-35%)	-5 (-27%)	-2 (-20%)
June	-5 (-5%)	-7 (-8%)	-7 (-8%)	-19 (-20%)	-19 (-21%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-2 (-3%)
August	0 (0%)	0 (0%)	-2 (-2%)	-4 (-4%)	-2 (-3%)
September	28 (42%)	28 (48%)	26 (53%)	17 (40%)	12 (43%)

15  
 16 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
 17 May through September (Table 11-1A-65). Only May and June were examined for spawning and egg  
 18 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-  
 19 months exceeding the threshold under Alternative 1A would be 13% to 15% lower than those under  
 20 NAA during May and June.

1 **Table 11-1A-65. Differences between Baseline and Alternative 1A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 64°F in the Feather River at Gridley, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
May	Wet	15 (250%)	-9 (-30%)
	Above Normal	10 (91%)	-4 (-16%)
	Below Normal	13 (163%)	-11 (-34%)
	Dry	26 (186%)	-3 (-7%)
	Critical	21 (124%)	1 (3%)
	All	86 (154%)	-25 (-15%)
June	Wet	42 (56%)	-25 (-18%)
	Above Normal	7 (14%)	-22 (-28%)
	Below Normal	9 (14%)	-23 (-24%)
	Dry	47 (50%)	-6 (-4%)
	Critical	39 (70%)	0 (0%)
	All	145 (43%)	-75 (-13%)
July	Wet	59 (35%)	43 (23%)
	Above Normal	33 (62%)	16 (23%)
	Below Normal	60 (88%)	28 (28%)
	Dry	98 (114%)	54 (42%)
	Critical	78 (99%)	24 (18%)
	All	328 (72%)	165 (27%)
August	Wet	54 (30%)	37 (19%)
	Above Normal	40 (89%)	18 (27%)
	Below Normal	64 (91%)	32 (31%)
	Dry	100 (147%)	22 (15%)
	Critical	50 (59%)	0 (0%)
	All	308 (69%)	109 (17%)
September	Wet	61 (156%)	88 (733%)
	Above Normal	23 (144%)	32 (457%)
	Below Normal	35 (125%)	-5 (-7%)
	Dry	50 (179%)	-2 (-3%)
	Critical	52 (260%)	-2 (-3%)
	All	221 (169%)	111 (46%)

4

5 ***San Joaquin River***

6 Flows in the San Joaquin River at Vernalis under Alternative 1A during March through June would  
 7 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
 8 *Analysis*).

9 No water temperature modeling was conducted in the San Joaquin River.

10 ***NEPA Effects:*** Collectively, these results indicate that the effect is not adverse because it does not  
 11 have the potential to substantially reduce the amount of suitable habitat. Flows in the Sacramento

1 and Feather Rivers under Alternative 1A would be similar or greater than those under the NEPA  
2 baseline and water temperature conditions would improve for green sturgeon under Alternative 1A.  
3 There would be no effects of Alternative 1A on flows in the San Joaquin River.

4 **CEQA Conclusion:** In general, Alternative 1A would not affect spawning and egg incubation habitat  
5 for green sturgeon relative to the Existing Conditions.

#### 6 **Sacramento River**

7 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
8 Bluff during the March to July spawning and egg incubation period for green sturgeon (Appendix  
9 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLTT would generally be  
10 similar to or greater (up to 24%) than those under Existing Conditions. Exceptions include in above  
11 normal and below normal years during March at Keswick (6% reduction), wet years during May in  
12 both locations (14% to 17% reduction depending on location and water year type), and below  
13 normal, dry, and critical water years during July in both locations (5% to 11% lower depending on  
14 location and water year type). Also, flows can be lower or higher in individual months of individual  
15 years. These results indicate that there would be very few reductions in flows in the Sacramento  
16 River under Alternative 1A relative to the Existing Conditions.

17 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
18 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
19 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
20 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
21 Existing Conditions and Alternative 1A in any month or water year type throughout the period.

22 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was  
23 determined for each month (May through September) and year of the 82-year modeling period  
24 (Table 11-1A-62). The combination of number of days and degrees above the 63°F threshold were  
25 further assigned a “level of concern”, as defined in Table 11-1A-12. Differences between baselines  
26 and Alternative 1A in the highest level of concern across all months and all 82 modeled years are  
27 presented in Table 11-1A-13. The number of “red” years would be 250% higher under Alternative  
28 1A relative to Existing Conditions.

29 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type  
30 during May through September (Table 11-1A-63). Water temperatures under Alternative 1A would  
31 exceed the threshold 59 degree-days (454%) and 9 degree-days (no relative change calculation  
32 possible due to division by 0) more than those under Existing Conditions during May and June,  
33 respectively. Water temperatures under Alternative 1A would exceed the threshold 667(8338%) to  
34 1873 (629%) degree-days more than those under Existing Conditions.

#### 35 **Feather River**

36 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
37 during February through June, flows under A1A\_LLTT would nearly always be similar to or greater  
38 (up to 204%) than those under Existing Conditions with few exceptions (Appendix 11C, *CALSIM II*  
39 *Model Results utilized in the Fish Analysis*). These results indicate that there would be very few  
40 reductions in flows in the Feather River under Alternative 1A relative to the Existing Conditions.

41 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
42 February through June green sturgeon spawning and egg incubation period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
2 *Fish Analysis*). There would generally be no differences (<5%) in mean monthly water temperature  
3 between Existing Conditions and Alternative 1A in any month or water year type throughout the  
4 period, except during February, in which mean monthly temperatures under Alternative 1A would  
5 be 6% lower than those under Existing Conditions.

6 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
7 was evaluated during May through September (Table 11-1A-64). For this impact, only the months of  
8 May and June were examined because spawning and egg incubation does not generally extend  
9 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131.  
10 During the period, the percent of months exceeding the threshold under Alternative 1A would be  
11 similar to or higher (up to 23% higher on an absolute scale) than the percent under Existing  
12 Conditions.

13 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
14 May through September (Table 11-1A-65). Only May and June were examined for spawning and egg  
15 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-  
16 months exceeding the threshold under Alternative 1A would be 43% to 154% higher than those  
17 under Existing Conditions during May and June.

### 18 ***San Joaquin River***

19 Flows in the San Joaquin River at Vernalis under Alternative 1A would be up to 38% lower than  
20 flows under Existing Conditions during the March through June spawning and egg incubation period  
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 No water temperature modeling was conducted in the San Joaquin River.

### 23 **Summary of CEQA Conclusion**

24 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between  
25 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
26 alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the  
27 NEPA conclusion set forth above. Flows in the Sacramento, Feather, and San Joaquin River would  
28 generally be similar between Alternative 1A and the CEQA baseline, but the exceedance above NMFS  
29 temperature thresholds would be greater in the Sacramento and Feather Rivers under Alternative  
30 1A.

31 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
32 change, future water demands, and implementation of the alternative. The analysis described above  
33 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
34 the alternative from those of sea level rise, climate change and future water demands using the  
35 model simulation results presented in this chapter. However, the increment of change attributable  
36 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
37 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
38 implementation period, which does include future sea level rise, climate change, and water  
39 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
40 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
41 effect of the alternative from those of sea level rise, climate change, and water demands.

1 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
2 term implementation period and Alternative 1A indicates that flows in the locations and during the  
3 months analyzed above would generally be similar between Existing Conditions during the LLT and  
4 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
5 found above would generally be due to climate change, sea level rise, and future demand, and not  
6 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
7 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
8 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is  
9 found to be less than significant and no mitigation is required.

### 10 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

11 In general, Alternative 1A would not affect the quantity and quality of green sturgeon larval and  
12 juvenile rearing habitat relative to NAA.

13 Water temperature was used to determine the potential effects of Alternative 1A on green sturgeon  
14 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
15 their habitat is more likely to be limited by changes in water temperature than flow rates.

#### 16 ***Sacramento River***

17 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
18 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
19 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
20 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative  
21 1A in any month or water year type throughout the period.

#### 22 ***Feather River***

23 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
24 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
25 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
26 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A in  
27 any month or water year type throughout the period.

28 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
29 was evaluated during May through September (Table 11-1A-64). The percent of months exceeding  
30 the threshold under Alternative 1A would be similar to or lower (up to 21% lower on an absolute  
31 scale) than the percent under NAA in all months except September, in which the percent of months  
32 under Alternative 1A would be 12% to 28% (absolute scale) lower than the percent under NAA.

33 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
34 May through September (Table 11-1A-65). Total degree-months exceeding the threshold under  
35 Alternative 1A would be 13% to 15% lower than those under NAA during May and June and 17% to  
36 46% greater than those under NAA during July through September.

#### 37 ***San Joaquin River***

38 Water temperature modeling was not conducted in the San Joaquin River.

39 ***NEPA Effects:*** Collectively, these results indicate that the effect is not adverse because it does not  
40 have the potential to substantially reduce the amount of suitable habitat. Water temperature

1 conditions in the Sacramento and Feather Rivers under Alternative 1A would generally be similar  
2 than those under the NEPA baseline.

3 **CEQA Conclusion:** In general, Alternative 1A would not affect the quantity or quality of green  
4 sturgeon larval and juvenile rearing habitat relative to the Existing Conditions.

5 Water temperature was used to determine the potential effects of Alternative 1A on green sturgeon  
6 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
7 their habitat is more likely to be limited by changes in water temperature than flow rates.

#### 8 **Sacramento River**

9 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
10 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
11 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
12 monthly water temperature under Alternative 1A would be similar to those under Existing  
13 Conditions during May and June, but 5% to 7% lower than those under Existing Conditions during  
14 July through October.

#### 15 **Feather River**

16 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
17 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
18 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
19 be no differences (<5%) in mean monthly water temperature between Existing Conditions and  
20 Alternative 1A in any month except August, in which temperatures under Alternative 1A would be  
21 5% greater than those under Existing Conditions.

22 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
23 was evaluated during May through September (Table 11-1A-64). The percent of months exceeding  
24 the threshold under Alternative 1A would be similar to or greater (up to 53% higher on an absolute  
25 scale) than the percent under Existing Conditions in all months during the period.

26 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
27 May through September (Table 11-1A-65). Total degree-months exceeding the threshold under  
28 Alternative 1A would be 43% to 169% greater than those under Existing Conditions depending on  
29 month.

#### 30 **San Joaquin River**

31 Water temperature modeling was not conducted in the San Joaquin River.

#### 32 **Summary of CEQA Conclusion**

33 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between  
34 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
35 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set  
36 forth above. Water temperatures under Alternative 1A would be greater than those under Existing  
37 Conditions during the majority of the rearing period in the Sacramento and Feather River and  
38 therefore, the exceedance above NMFS temperature thresholds would be greater in the Feather  
39 River.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
4 the alternative from those of sea level rise, climate change and future water demands using the  
5 model simulation results presented in this chapter. However, the increment of change attributable  
6 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
7 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 1A indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than  
20 significant and no mitigation is required.

### 21 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

22 In general, Alternative 1A would reduce green sturgeon migration conditions relative to NAA.

23 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
24 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with  
25 the Sacramento River during the April through October larval migration period, the August through  
26 March juvenile migration period, and the November through June adult migration period (Appendix  
27 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the  
28 entire year, flows during all months were compared. Reduced flows could slow or inhibit  
29 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration  
30 cues and pass impediments by adults.

31 Sacramento River flows under A1A\_LL1T would generally be similar to or greater than flows under  
32 NAA in all months except July through September and November, during which flows would be up to  
33 46% lower depending on location, month, and water year type.

34 Larval transport flows were also examined by utilizing the positive correlation between white  
35 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the  
36 assumption that the mechanism responsible for the relationship is that Delta outflow provides  
37 improved green sturgeon larval transport that results in improved year class strength. Results for  
38 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation  
39 between Delta outflow and year class strength, green sturgeon year class strength would be lower  
40 under Alternative 1A.

41 Feather River flows under A1A\_LL1T would generally be lower by up to 86% than those under NAA  
42 during July through September. Flows during other months under A1A\_LL1T would generally be  
43 similar to or greater than flows under NAA with some exceptions.

1 **NEPA Effects:** Collectively, these results indicate that the effect is adverse because it has the  
2 potential to substantially interfere with the movement of green sturgeon. Reductions in flows in the  
3 Sacramento and Feather Rivers during substantial portions of the migration period could slow or  
4 inhibit migration.

5 This effect is a result of the specific reservoir operations and resulting flows associated with this  
6 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
7 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
8 the alternative, thereby making it a different alternative than that which has been modeled and  
9 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
10 mitigation available. Even so, the mitigation measures listed below have the potential to reduce the  
11 severity of impact, but not necessarily to a level considered not adverse.

12 **CEQA Conclusion:** In general, Alternative 1A would reduce green sturgeon migration conditions  
13 relative to the Existing Conditions.

14 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
15 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with  
16 the Sacramento River during the April through October larval migration period, the August through  
17 March juvenile migration period, and the November through July adult migration period (Appendix  
18 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the  
19 entire year, flows during all months were compared. Reduced flows could slow or inhibit  
20 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration  
21 cues and pass impediments by adults.

22 Sacramento River flows under A1A\_LLТ would generally be similar to or greater than flows under  
23 Existing Conditions in all months except July through September, and November when flows  
24 generally decreased by up to 28%. Flows during other months would generally be similar to or  
25 greater than flows under Existing Conditions.

26 Flows in the Feather River under A1A\_LLТ would generally be up to 60% lower than flows under  
27 Existing Conditions in June through September, and November. Flows during other months under  
28 A1A\_LLТ would generally be similar to or greater than flows under Existing Conditions.

29 For Delta outflow, the percent of months exceeding flow thresholds under A1A\_LLТ would  
30 consistently be lower than those under Existing Conditions for each flow threshold, water year type,  
31 and month (16% to 75% lower on a relative scale) (see Table 11-1A-70 below).

### 32 **Summary of CEQA Conclusion**

33 Collectively, these results indicate that the impact would be significant because it has the potential  
34 to substantially interfere with the movement of fish. The reduction in flows in the Sacramento River  
35 during August, September, and November and in the Feather River during July, August, September,  
36 November, and December would affect larval and juvenile migration period, which could slow or  
37 inhibit their downstream migration.

38 This impact is a result of the specific reservoir operations and resulting flows associated with this  
39 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
40 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
41 change the alternative, thereby making it a different alternative than that which has been modeled  
42 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible

1 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
2 severity of impact though not necessarily to a less-than-significant level.

3 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**  
4 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**  
5 **Mitigation to Reduce Impacts to Migration Conditions**

6 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
7 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
8 the best available scientific information at the time and may prove to have been over- or  
9 understated. Upon the commencement of operations of CM1 and continuing through the life of  
10 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
11 whether such effects would be as extensive as concluded at the time of preparation of this  
12 document and to determine any potentially feasible means of reducing the severity of such  
13 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
14 consistent with the operational framework for Alternative 1A.

15 The development and implementation of any mitigation actions shall be focused on those  
16 incremental effects attributable to implementation of Alternative 1A operations only.  
17 Development of mitigation actions for the incremental impact on migration habitat attributable  
18 to climate change/sea level rise are not required because these changed conditions would occur  
19 with or without implementation of Alternative 1A.

20 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
21 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

22 Following commencement of initial operations of CM1 and continuing through the life of the  
23 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
24 modified operations could reduce impacts to migration habitat under Alternative 1A. The  
25 analysis required under this measure may be conducted as a part of the Adaptive Management  
26 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

27 **Mitigation Measure AQUA-132c: Consult with USFWS and CDFW to Identify and**  
28 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
29 **Conditions Consistent with CM1**

30 In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon  
31 habitat, the BDCP proponents will consult with USFWS and the Department of Fish and Wildlife  
32 to identify and implement any feasible operational means to minimize effects on migration  
33 habitat. Any such action will be developed in conjunction with the ongoing monitoring and  
34 evaluation of habitat conditions required by Mitigation Measure AQUA-132a.

35 If feasible means are identified to reduce impacts on migration habitat consistent with the  
36 overall operational framework of Alternative 1A without causing new significant adverse  
37 impacts on other covered species, such means shall be implemented. If sufficient operational  
38 flexibility to reduce effects on green sturgeon habitat is not feasible under Alternative 1A  
39 operations, achieving further impact reduction pursuant to this mitigation measure would not  
40 be feasible under this Alternative, and the impact on green sturgeon would remain significant  
41 and unavoidable.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

3 ***Temporary Increases in Turbidity***

4 Restoration construction activities such as riprap removal, shoreline excavation and re-contouring,  
5 and planting riparian vegetation have the potential to result in temporary increases in turbidity  
6 conditions in adjacent waterways. However, green sturgeon inhabit naturally turbid water and are  
7 unlikely to be affected by temporary increases in turbidity during restoration construction.

8 Implementation of environmental commitments described under Impact AQUA-1 for delta smelt  
9 and in Appendix 3B, *Environmental Commitments*, would minimize the potential for turbidity to  
10 affect green sturgeon. These environmental commitments include *Environmental Training*;  
11 *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials*  
12 *Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan*; *Disposal of Spoils*,  
13 *Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*.

14 ***Increased Exposure to Mercury***

15 As discussed above for delta smelt (Impact AQUA-7), the implementation of *CM12 Methylmercury*  
16 *Management* would minimize potential effects of methylmercury mobilization from restoration  
17 sites, on green sturgeon. As a result, restoration activities are not likely to produce the  
18 biogeochemical conditions that would support methylation of mercury; thus increased  
19 bioavailability and toxicity as a result of restoration activities are not expected. However, the cycling  
20 of mercury is a complicated process, and is difficult to predict based on existing information.

21 ***Accidental Spills***

22 As discussed above for construction and maintenance activities (see Impact AQUA-1 and Impact  
23 AQUA-2 for delta smelt), implementation of environmental commitments described in Appendix 3B,  
24 *Environmental Commitments*, would minimize the potential for introduction of contaminants to  
25 surface waters and provide for effective containment and cleanup should accidental spills occur.  
26 These environmental commitments are *Environmental Training*; *Stormwater Pollution Prevention*  
27 *Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; and *Spill*  
28 *Prevention, Containment, and Countermeasure Plan*. Pertinent details of these plans are provided  
29 under Impact AQUA-1 for delta smelt.

30 ***Disturbance of Contaminated Sediments***

31 Runoff and resuspension of contaminants could cause short-term, localized increases in the  
32 concentrations of contaminants in and near restoration sites (see discussion for delta smelt under  
33 Impact AQUA-7). Sturgeon typically feed on prey items that are associated with the substrate, and  
34 are prone to exposure to sediment borne toxicants. They also tend to bioaccumulate toxicants that  
35 occur in the Plan Area, such as methylmercury, pesticides and selenium, and spend several years  
36 rearing in the Plan Area. As a result, they have an increased risk of effects from disturbances of  
37 contaminated sediments. Adhering to the expected in-water construction window would provide  
38 limited protection for sturgeon, because juvenile sturgeon can occur in the Plan Area throughout the  
39 year. Although juvenile sturgeon could be present during the in-water work window, the limited  
40 frequency and duration and spatial extent of in-water restoration activities, and implementation of  
41 environmental commitments (see Appendix 3B), would minimize exposure levels. These

1 environmental commitments are *Environmental Training; Stormwater Pollution Prevention Plan;*  
2 *Erosion and Sediment Control Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
3 *Material; and Barge Operations Plan.* Pertinent details of these plans are provided under Impact  
4 AQUA-1 for delta smelt. Because of the temporary nature of toxicity spikes, the potential effects  
5 would be minimized.

### 6 ***In-Water Work Activities***

7 Restoration construction activities could temporarily produce noise levels and disturbances that  
8 could affect nearby fishes. Such activities are not expected to elevate underwater noise above the  
9 threshold sound pressure levels established for fish (see discussion for delta smelt under Impact  
10 AQUA-1). Any changes in disturbance levels would be minor and temporary, and fish are expected to  
11 generally avoid areas where shoreline construction activities are occurring. Potential effects of in-  
12 water activity would be minimized by implementation of the environmental commitments  
13 described under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*, including  
14 *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material;*  
15 *and Barge Operations Plan.*

### 16 ***Predation***

17 The creation of permanent tidal brackish habitat within Suisun Marsh would create permanent year-  
18 round rearing habitat for juvenile green sturgeon. Once these habitats became fully established they  
19 are expected to provide highly productive food and refuge habitats. Due to their salinities, these  
20 habitats would be expected to provide some refuge from black bass. Also since younger juvenile  
21 sturgeon are less tolerant of saltwater, juveniles that occupy these brackish habitats are likely larger  
22 and have developed armored bony plating to substantially reduce predation vulnerability.

### 23 ***Summary***

24 In-water and shoreline construction activities associated with habitat restoration would be  
25 scheduled to occur when the least number of green sturgeon would be present in or near the  
26 restoration sites. Such activities would include riprap removal and levee breaching, and shoreline  
27 excavation and re-contouring. In addition, runoff from upland construction areas would also have  
28 the potential to affect aquatic habitats and green sturgeon. Green sturgeon are tolerant to increases  
29 in turbidity, which might occur during shoreline restoration construction activities. Implementation  
30 of the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix  
31 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
32 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
33 *Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and*  
34 *Dredged Material)*, would minimize or eliminate effects on green sturgeon (see Impact AQUA-7).

35 While implementation of these environmental commitments would minimize or eliminate short-  
36 term effects occurring during restoration construction, long-term effects could also occur. For  
37 example, removing or breaching levees would result in the expansion of floodplain habitat, and  
38 more frequent inundation these areas, potentially promoting conversion of mercury to methylated  
39 mercury, and runoff containing agricultural-related toxins such as copper and organochlorine  
40 pesticides. However, the overall effect of increased bioavailability of methylmercury and other  
41 pollutants on green sturgeon is likely to be of low magnitude, periodic and localized. In addition,  
42 potential increases would be minimized to the extent possible because of implementation of *CM12*  
43 *Methylmercury Management* (see Impact AQUA-10).

1 **NEPA Effects:** For these reasons, green sturgeon would not be adversely affected by restoration  
2 construction activities.

3 **CEQA Conclusion:** Green sturgeon inhabit naturally turbid water and are not expected to be affected  
4 by temporary increases in turbidity during restoration construction activities. In addition to the  
5 limited frequency and duration and spatial extent of in-water restoration activities and  
6 implementation of the environmental commitments identified above and described in detail under  
7 Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments (Environmental*  
8 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
9 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of*  
10 *Spoils, Reusable Tunnel Material, and Dredged Material)*, would minimize the potential for turbidity,  
11 accidental spills, resuspension of contaminated sediments, or construction noise to affect green  
12 sturgeon. Therefore, this impact is considered less than significant for green sturgeon because it  
13 would not substantially reduce habitat, restrict its range or interfere with its movement.  
14 Consequently, no mitigation would be required.

### 15 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green** 16 **Sturgeon**

17 As described for delta smelt (see Impact AQUA-8), effects on covered fish species will depend on the  
18 species/life stage present in the area of elevated toxins and the duration of exposure. A complete  
19 analysis can be found in the *BDCP Effects Analysis – Appendix D, Contaminants (hereby incorporated*  
20 *by reference)*. Potential impacts on green sturgeon from effects of methylmercury, copper, ammonia,  
21 and pesticides associated with habitat restoration activities would also be similar to those discussed  
22 for delta smelt (see Impact AQUA-8). The effects of selenium are influenced by different factors,  
23 which are discussed below.

24 A description of the potential for mobilization and bioavailability of selenium associated with  
25 restorations measures is included in impact AQUA-8, which addresses delta smelt specifically. There  
26 is a greater potential for effects on green sturgeon than delta smelt because sturgeon are bottom  
27 feeders, and selenium can bioaccumulate in some sessile filter feeders, such as clams.

28 An increase of residence time, due to BDCP activities, in areas with dense clam populations (such as  
29 Suisun Bay) and benthic-feeding covered fish species (such as sturgeon), could result in increased  
30 mobilization and bioaccumulation of selenium in the food chain of benthic-feeding fish. However,  
31 residence time is directly related to outflow in Suisun Bay, and CALSIM modeling results indicate  
32 that outflow and residence time will not change significantly under Alternative 1A, and effects on  
33 selenium biogeochemical cycling are not anticipated. Comparison of the monthly mean residence  
34 time (averaged over years 1992 through 2003) indicates that residence time in Suisun Bay may  
35 change from a decrease of 13 days to an increase of 5 days. Because mobilization of selenium due to  
36 increased residence time is not expected, effects related to BDCP restoration activities on sturgeon  
37 feeding on clams in Suisun Bay are expected to be limited, but would need to be evaluated on a site-  
38 specific basis.

39 The higher contribution of San Joaquin River flow to Delta outflow in Alternative 1A relative to the  
40 NAA is expected to increase the loading and by extension possibly the bioaccumulation of selenium  
41 in the low-salinity zone food web. However, regulation of both Grasslands in the San Joaquin River  
42 basin and oil refineries near Suisun Bay could help in decreasing the loading of selenium to the  
43 Delta. Because selenium would be mobilized into the food chain under a narrow set of conditions,  
44 the overall effects within the Plan Area are likely low.

1 **NEPA Effects:** While Alternative 1A actions are likely to result in increased production, mobilization,  
2 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system, any  
3 such releases would be short-term and localized, and would be unlikely to result in measurable  
4 increases in the bioaccumulation in green sturgeon. Although green sturgeon are known to  
5 bioaccumulate selenium due in large part to their consumption of the overbite clam (*C. amurensis*),  
6 habitat restoration measures under Alternative 1A are expected to have little effect on selenium  
7 bioaccumulation in the Plan Area. Overall, the effects of contaminants associated with restoration  
8 measures would not be adverse for green sturgeon with respect to copper, ammonia and pesticides.  
9 The effects of methylmercury and selenium on green sturgeon are uncertain.

10 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
11 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
12 However, such releases would typically be short-term and localized, and would be unlikely to result  
13 in measurable increases in the bioaccumulation in green sturgeon. For selenium, evaluation of the  
14 factors that influence its bioavailability and bioaccumulation indicate a low probability for effects.  
15 For methylmercury, implementation of *CM12 Methylmercury Management* would help to minimize  
16 the increased mobilization of methylmercury at restoration areas. Therefore, the impact of  
17 contaminants is considered less than significant because it would not substantially effect green  
18 sturgeon either directly or through habitat modifications and, with restoration, would be beneficial  
19 in the long-term. Consequently, no mitigation would be required.

#### 20 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

21 For discussion of the potential effects on green sturgeon, see the discussion under Impact AQUA-9  
22 for delta smelt.

#### 23 **CM2 Yolo Bypass Fisheries Enhancement**

24 As discussed under Impact AQUA-9, Yolo Bypass fisheries enhancement modifications are designed  
25 to increase the frequency, duration and magnitude of seasonal floodplain inundation in the Yolo  
26 Bypass. These actions would improve passage and habitat for sturgeon. These modifications, which  
27 include fish passage improvements and flow management, would reduce migratory delays and loss  
28 of sturgeon at Fremont Weir and other structures. The Yolo Bypass would potentially provide  
29 temporary habitat for green sturgeon but would not be a substantial benefit.

#### 30 **CM4 Tidal Natural Communities Restoration**

31 For discussion of the effect on green sturgeon, see the discussion under Impact AQUA-9.

32 Although tidal habitat restoration would benefit green sturgeon, habitat conditions are likely to  
33 decrease for juvenile sturgeon over time, because of temperature effects associated with climate  
34 change during the late spring. It is anticipated that the overall effect of *CM4 Tidal Natural*  
35 *Communities Restoration* would remain positive because increases in habitat quantity are greater  
36 than decreases in quality, providing a mechanism to at least partially offset the future effects of  
37 climate change (see Impact AQUA-9).

38 As discussed under Impact AQUA-9, increased food productivity is expected in all ROAs as a result of  
39 the BDCP, but the Suisun Marsh, Cache Slough, and South Delta ROAs are expected to see the  
40 greatest increases in productivity. Sturgeon feed on benthic invertebrates, including those found on  
41 marsh mudflats, which will benefit from the transfer of increased production to mudflat fauna in  
42 restored marshes. Therefore, the substantial increase in these habitats would likely increase total

1 food availability for sturgeon. While green sturgeon are not expected to extensively use floodplain  
2 or floodplain wetland habitat, potential increases in food resources from seasonal inundation of  
3 these habitats is considered beneficial to the species.

#### 4 ***CM5 Seasonally Inundated Floodplain Restoration***

5 Periodic inundation of the restored floodplain also will benefit sturgeon by cycling nutrients,  
6 supporting growth of plankton and aquatic insects. Providing river–floodplain connectivity would  
7 increase production of lower trophic levels at relatively rapid time scales, with some food web  
8 organisms responding within days at high densities. Although food is not likely a limiting factor to  
9 the abundance of sturgeon in the Delta, BDCP actions, notably the restoration and enhancement of  
10 upstream habitats, may increase sturgeon food availability relative to Existing Conditions. If the  
11 upstream productivity transfer occurs at the planktonic level, downstream benthic habitats utilized  
12 for foraging by adult sturgeon may experience a greater increase in productivity due to the potential  
13 increase in *Corbula* than if this upstream transfer occurs at higher trophic levels, such as  
14 planktivorous fish.

15 BDCP habitat restoration would also increase the availability of foraging and refuge habitats  
16 available to rearing juvenile sturgeon. For further discussion, see Impact AQUA-9.

#### 17 ***CM6 Channel Margin Enhancement***

18 Expanded nearshore habitat with improved inputs of terrestrial organic matter and insects, as well  
19 as woody material, riparian shade, and underwater cover will increase the quality and area of  
20 potential rearing habitat for sturgeon. Enhancements are also expected to improve migration  
21 conditions for sturgeon, by increasing the availability and quality of resting (refuge) habitat as a  
22 result of increased channel margin complexity (e.g., woody material), particularly during high flows.

23 Despite the potential benefits of channel margin habitat on green sturgeon, the overall effect is  
24 expected to be minimal because of the relatively short period of their life history spent in these  
25 shallow nearshore areas; therefore, the effect is not considered adverse. For further discussion see  
26 Impact AQUA-9.

#### 27 ***CM7 Riparian Natural Community Restoration***

28 White and green sturgeon rely on ecological attributes of valley/foothill riparian habitat in the Plan  
29 Area. BDCP habitat restoration, including riparian restoration, are expected to improve the quality  
30 and quantity of Delta rearing habitats for juvenile sturgeon. Once established, these habitats would  
31 likely provide suitable food resources for juvenile sturgeon. For further discussion, see Impact  
32 AQUA-9.

#### 33 ***CM10 Nontidal Marsh Restoration***

34 As discussed under delta smelt, upland restoration under *CM10 Nontidal Marsh Restoration* is  
35 expected to have minor indirect beneficial effects on green sturgeon in the main river systems and  
36 Delta. These upland wetlands provide hydrologic and water quality functions, such as storing water  
37 during floods and filtering contaminants. These sites would also provide some additional food  
38 resources such as insects, zooplankton, phytoplankton and dissolved organic carbon. These  
39 materials would be exported during flood stages when the upland might be connected to the river  
40 system. Although the contribution from 400 acres would be small, it would be beneficial. For  
41 additional discussion, see Impact AQUA-9.

1 **NEPA Effects:** The effects of floodplain, tidal, channel margin and riparian habitat restoration  
2 activities on green sturgeon are expected to be similar to those discussed for delta smelt (see Impact  
3 AQUA-9). In general these effects are expected to be beneficial for green sturgeon, although the  
4 primary benefits are likely to be the result of increased productivity from more frequent  
5 inundations of restoration areas and increased amount and quality of available rearing and  
6 migration habitat.

7 Despite the improvements in habitat and habitat functions in the Delta from floodplain, tidal,  
8 channel margin and riparian habitat restoration activities, habitat quality is expected to decline in  
9 the LLT primarily because of climate change. However, the overall effect of restoration activities is  
10 expected to remain beneficial for green sturgeon.

11 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
12 management plan would be needed to determine an operational protocol that optimizes benefits  
13 both locally and in adjacent habitats.

14 **CEQA Conclusion:** As with delta smelt, the overall effects of floodplain, tidal, channel margin and  
15 riparian habitat restoration activities are expected to be beneficial for green sturgeon (see Impact  
16 AQUA-9). The primary benefits are likely due to increased productivity from more frequent  
17 inundations of restoration areas and increased amount and quality of available rearing and  
18 migration habitat. Despite the improvements in habitat and habitat functions in the Delta from these  
19 restoration activities, habitat quality is expected to decline in the LLT, primarily because of climate  
20 change. However, the overall impact of restoration activities is expected to remain beneficial for  
21 green sturgeon because they increase habitat. Consequently, no mitigation would be required.

## 22 **Other Conservation Measures (CM12–CM19 and CM21)**

### 23 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

24 Refer to Impact AQUA-10 under delta smelt for a discussion of the potential effects of  
25 methylmercury management on green sturgeon.

### 26 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon 27 (CM13)**

28 The following analysis is based on the more detailed analysis included in *BDCP Effects Analysis –  
29 Appendix F, Biological Stressors, Section F.1.1 Invasive Aquatic Vegetation, Section F.4 Invasive Aquatic  
30 Vegetation, and F.5.3.2.3 Nonnative Aquatic Vegetation Control (Conservation Measure 13) (hereby  
31 incorporated by reference).*

32 A general analysis of the effects on covered fish species has been conducted that was described  
33 above for delta smelt (see Impact AQUA-11). Potential impacts on green sturgeon from IAV control  
34 during operations are similar to those discussed for delta smelt. The control of IAV with  
35 implementation of *CM13 Invasive Aquatic Vegetation Control* is expected to maintain or improve  
36 turbidity conditions that could benefit green sturgeon rearing conditions, reducing their  
37 susceptibility to predation. Sturgeon grow rapidly and can quickly outgrow the size range where  
38 predation could occur. Sturgeon also have a protective armour like plating making them unappealing  
39 to predators even at a young age (French et al. 2010). Therefore the impact of IAV removal on  
40 predation risk for sturgeon is expected to be slight.

1 The control of IAV would also increase the amount of rearing habitat, as well as access to the habitat  
2 and potential increases in food availability.

3 **NEPA Effects:** The effects of IAV control are expected to provide an overall benefit to green sturgeon.

4 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to green sturgeon during  
5 operations through chemical and mechanical treatment and is considered a beneficial impact by  
6 reducing predation mortality, increasing food availability, and increasing rearing habitat. This  
7 impact is expected to be beneficial.

#### 8 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

9 **NEPA Effects:** As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very  
10 similar to Existing Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP  
11 export service areas (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14*  
12 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would increase the dissolved  
13 oxygen levels and improve aquatic habitat conditions for green sturgeon. The effect would be  
14 beneficial for green sturgeon.

15 **CEQA Conclusion:** As discussed in Chapter 8, *Water Quality*, *CM14 Stockton Deepwater Ship Channel*  
16 *Dissolved Oxygen Levels* management would increase the dissolved oxygen levels and improve  
17 aquatic habitat conditions. Green sturgeon occur in the channel and the increased dissolved oxygen  
18 levels also provide improved habitat conditions for them, which would be a benefit. Consequently,  
19 no mitigation would be required.

#### 20 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon** 21 **(CM15)**

22 To the extent that localized predator control efforts of *CM15 Localized Reduction of Predatory Fish*  
23 reduce the overall abundance of fish predators in the Delta occupied by green sturgeon, it is  
24 possible, but not assured that there would be some reduction in losses to predation, although no  
25 quantitative information is available regarding the current magnitude of green sturgeon loss to  
26 predation (see Impact AQUA-13). Due to these uncertainties, there would be no demonstrable effect  
27 of this conservation measure on green sturgeon.

28 Additionally, although little is known about predation of juvenile sturgeon in the Delta they grow  
29 rapidly in their first year of development (probably reaching 30 cm (12 inches) in their first year,  
30 Kohlhorst and Cech 2001a) and grow protective bony plating at an early age. Due to their rapid  
31 growth early in their development, the period in which juvenile sturgeon are vulnerable to  
32 piscivorous fish predators in the Delta is likely limited, and therefore the potential beneficial effects  
33 from implementation of *CM15 Localized Reduction of Predatory Fish* are likely limited.

34 One potential risk of localized predator removal is by-catch of sturgeon during beach seining, gill  
35 netting, angling, electrofishing, or other capture methods. Sturgeon tend to reside in deep water  
36 areas and should be protected from electrofishing, however they would be more susceptible to  
37 injury because of their large size. Striped bass monitoring by CDFW at Knights Landing using fyke  
38 traps caught four adult green sturgeon in 16,100 hours; gillnetting on the lower Sacramento  
39 resulted in the capture of two green sturgeon in 15,450 hours. (Dubois and Mayfield 2009; Dubois et  
40 al. 2010). Adult sturgeon aren't susceptible to being caught using artificial lures commonly used to  
41 catch striped bass but would be susceptible to baited hooks. Injuries to sturgeon would be similar to

1 those experiences by salmonids listed above. Adult sturgeon in deep water should be able to avoid  
2 most types of nets. Adult sturgeon caught in nets (fyke, beach seine, or gill nets) could suffer similar  
3 injuries as salmonids such as ones listed above. However, the number of sturgeon affected by this  
4 variety of methods is expected to be very low.

5 **NEPA Effects:** The overall effect would not be adverse.

6 **CEQA Conclusion:** Due to the uncertainties concerning overall fish predator reduction and actual  
7 predation rates on green sturgeon in the Delta, there would be no demonstrable effect from this  
8 conservation measure on green sturgeon. Little is known about predation of juvenile sturgeon in the  
9 Delta. Sturgeon grow rapidly in their first year of development and grow protective bony plating at  
10 an early age. Due to rapid early growth, the period in which juvenile sturgeon are vulnerable to  
11 piscivorous fish predators in the Delta is likely limited, and therefore the potential beneficial  
12 impacts from implementation of *CM15 Localized Reduction of Predatory Fish* are likely limited.

13 One potential risk of localized predator removal is by-catch of sturgeon during beach seining, gill  
14 netting, angling, electrofishing, or other capture methods. Sturgeon tend to reside in deep water  
15 areas and should be protected from electrofishing, however they would be more susceptible to  
16 injury because of their large size. Striped bass monitoring by CDFW at Knights Landing using fyke  
17 traps caught four adult green sturgeon in 16,100 hours; gillnetting on the lower Sacramento  
18 resulted in the capture of two green sturgeon in 15,450 hours. (Dubois and Mayfield 2009; Dubois et  
19 al. 2010). Adult sturgeon aren't susceptible to being caught using artificial lures commonly used to  
20 catch striped bass but would be susceptible to baited hooks. Adult sturgeon in deep water should be  
21 able to avoid most types of nets. However, the number of sturgeon affected by this variety of  
22 methods is expected to be very low. The impact is considered less than significant because it would  
23 not have a substantial effect on their numbers. Consequently, no mitigation would be required.

#### 24 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

25 **NEPA Effects:** Green sturgeon are not known to currently spawn in the San Joaquin River although  
26 they may have historically (Moyle 2002; Beamesderfer et al. 2007). Therefore, the level of  
27 interaction of sturgeon juveniles with the Old River NPB is likely to be minimal. Green sturgeon are  
28 known to spawn upstream in the upper Sacramento River basin (Moyle 2002), and emigrating  
29 juveniles would likely encounter the Georgiana Slough barrier. Sturgeon may also be deterred by the  
30 sound and lights of the barrier (Popper 2005; Meyer et al. 2010; Halvorsen et al. 2012) thereby  
31 minimizing their entry into areas of the central Delta where high predation rates would be likely.  
32 Also, due to the armored scutes (bony external scale) and rapid growth of sturgeon, predation  
33 would likely be low following the early life stages (French et al. 2010). No overall adverse effect on  
34 green sturgeon is likely from NPBs.

35 **CEQA Conclusion:** Green sturgeon are not known to currently spawn in the San Joaquin River  
36 although they may have historically (Moyle 2002; Beamesderfer et al. 2007). Therefore, the level of  
37 interaction of sturgeon juveniles with the Old River NPB is likely to be minimal. Green sturgeon are  
38 known to spawn upstream in the upper Sacramento River basin (Moyle 2002), and emigrating  
39 juveniles would likely encounter the Georgiana Slough barrier. Sturgeon may also be deterred by the  
40 sound and lights of the barrier (Popper 2005; Meyer et al. 2010; Halvorsen et al. 2012) thereby  
41 minimizing their entry into areas of the central Delta where high predation rates would be likely.  
42 Also, due to the armored scutes (bony external scale) and rapid growth of sturgeon, predation  
43 would likely be low following the early life stages. The overall impact on green sturgeon from NPBs

1 is less than significant because it would not substantially reduce their numbers. Consequently, no  
2 mitigation would be required.

3 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

4 **NEPA Effects:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley  
5 steelhead, green sturgeon and white sturgeon and are expected to have beneficial effects on their  
6 populations.

7 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
8 Valley steelhead, green sturgeon and white sturgeon. Although the numbers cannot be quantified  
9 implementation is expected to have positive effects on their populations. The impact would be  
10 beneficial because it would increase the numbers of progeny in the next generation. Consequently,  
11 no mitigation would be required.

12 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

13 **NEPA Effects:** *CM18 Conservation Hatcheries* would establish new and expand existing conservation  
14 propagation programs for delta and longfin smelt. This conservation measure would have no effect  
15 on green sturgeon.

16 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing  
17 conservation propagation programs for delta and longfin smelt. This conservation measure would  
18 have no impact on green sturgeon. Consequently, no mitigation would be required.

19 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

20 **NEPA Effects:** The effects of Urban stormwater treatment (CM19) would reduce contaminants  
21 associated with urban areas because it provides for the treatment of stormwater discharges. As  
22 discussed in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled  
23 *Pyrethroids, Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment  
24 would reduce urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and  
25 other contaminants. These reductions would contribute to improved water quality in the Delta.  
26 Based on the improved overall water quality conditions and reduced pesticides the effect would be  
27 beneficial.

28 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
29 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
30 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
31 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
32 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
33 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore,  
34 the impacts of urban stormwater treatment would be beneficial because it would have a beneficial  
35 effect both directly and through habitat modifications on green sturgeon. Consequently, no  
36 mitigation would be required.

37 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
38 **Sturgeon (CM21)**

39 **NEPA Effects:** As discussed above for other species, there is no evidence of substantial entrainment  
40 of covered fish species at agricultural diversions in the Plan Area, but slight reductions in

1 entrainment are expected from decommissioning agricultural diversions in the ROAs (see Impact  
2 AQUA-18). : These effects would not be adverse and may be beneficial.

3 **CEQA Conclusion:** Although there is no evidence of substantial entrainment of covered fish species  
4 at agricultural diversions in the Plan Area, slight reductions in entrainment are expected from  
5 decommissioning agricultural diversions in the ROAs (see Impact AQUA-18). This impact would be  
6 less than significant and may result in a slight benefit to green sturgeon because it would reduce  
7 entrainment which would have a positive impact on green sturgeon numbers. Consequently, no  
8 mitigation would be required.

## 9 **White Sturgeon**

### 10 **Construction and Maintenance of CM1**

#### 11 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

12 Juvenile and adult spawning white sturgeon could be present in the vicinity of the intake and barge  
13 landings during in-water construction. Table 11-4 illustrates the life stages of white sturgeon  
14 present in the north, east, and south Delta during the expected in-water construction window (June  
15 1–October 31). Juveniles may be present year-round in all the construction areas. The potential for  
16 exposure of white sturgeon to construction-related activities is expected to be relatively high, but  
17 would likely be limited to two construction seasons (one for installation of cofferdams and barge  
18 landings, and one for removal of cofferdams and barge landings).

#### 19 **Temporary Increases in Turbidity**

20 Because white sturgeon are benthic fish, they inhabit naturally turbid water. They are unlikely to be  
21 affected by a temporary increase in turbidity. As discussed for delta smelt (see Impact AQUA-1),  
22 environmental commitments would be implemented to minimize turbidity during construction  
23 activities (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental Commitments:*  
24 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
25 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;*  
26 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and*  
27 *Barge Operations Plan*).

#### 28 **Accidental Spills**

29 Potential impacts on white sturgeon from accidental spills during construction are similar to those  
30 discussed for delta smelt (see Impact AQUA-1). Implementing the environmental commitments  
31 described under Impact AQUA-1 for delta smelt, and in Appendix 3B, *Environmental Commitments*  
32 *(Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
33 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan)*,  
34 and specifically the *Spill Prevention, Containment, and Countermeasure Plan*, would be expected to  
35 minimize the potential for introduction of contaminants to surface waters and provide for effective  
36 containment and cleanup should accidental spills occur.

#### 37 **Disturbance of Contaminated Sediments**

38 There is a potential risk of contaminated sediments affecting white sturgeon during construction of  
39 intake and barge landings if they are present in the vicinity of in-water construction activities (see  
40 Impact AQUA-1 for delta smelt). These risks include the potential for reduced reproduction and

1 growth rates, as well as potentially higher mortality rates, particularly for larval and juvenile life  
2 stages (Silvestre et al. 2010; Lee et al. 2011). Because white sturgeon are mainly benthic dwellers,  
3 they may be more susceptible to contaminants than other fish species. However, the suspension of  
4 sediments would be minimized by implementation of environmental commitments described under  
5 Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments (Environmental*  
6 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
7 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of*  
8 *Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge*  
9 *Operations Plan).*

#### 10 **Underwater Noise**

11 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
12 white sturgeon. It is important to note that this impact would be realized only where piles must be  
13 impact driven ; underwater sound generated by vibratory pile installation methods are not  
14 sufficiently loud to injure fish.

15 White sturgeon eggs and larvae could experience underwater sound effects because they are  
16 expected to occur in the locations of the intakes and barge landings during the in-water construction  
17 period, and would be affected by underwater noise levels that exceed injury or disturbance  
18 thresholds (see Impact AQUA-1). Juvenile and adult white sturgeon could be present near the  
19 intakes during June through October, when pile driving would occur, as they migrate to and from  
20 upstream spawning areas. Adult white sturgeon are large and less susceptible to noise from impact  
21 driving, and are able to avoid injurious exposure to underwater noise from pile driving. They may  
22 experience short delays in migration past the intakes when pile driving occurs; however, pile driving  
23 would occur only intermittently through a portion of the day, and minor migration delays would not  
24 affect their ability to successfully reach spawning grounds. Therefore, the potential for adult white  
25 sturgeon to experience an adverse effect (e.g., injury or mortality, or substantial migratory  
26 disturbance) from impact pile driving would be low-to-moderate because of their size, ability to  
27 move away from the underwater sound, and their potentially low temporal and spatial distribution  
28 during construction. Furthermore, potential exposure of white sturgeon to underwater sound above  
29 the threshold criterion would be intermittent and limited.

30 Juvenile white sturgeon would have relatively low densities near the intakes and barge landings  
31 throughout the June through October pile driving period. Given these numbers in the east and south  
32 Delta areas; the relatively small areas affected by underwater noise in these areas; and the  
33 intermittent nature of potential exposure to underwater sound above the threshold, there is a low  
34 chance that juvenile white sturgeon would be exposed to noise levels from impact pile driving at the  
35 barge landing sites. However, a greater number of juveniles could be present in the north Delta  
36 during construction of the intake cofferdams, resulting in a moderate risk of exposure to potentially  
37 harmful underwater sound levels. Therefore, there is a moderate potential for juvenile white  
38 sturgeon to experience an adverse effect (e.g., injury or mortality).

39 If an individual juvenile white sturgeon were present in an area affected by underwater sound from  
40 impact pile driving above the 183-dB SEL<sub>cumulative</sub> effects threshold level, and proximate to an  
41 impact-driven pile, it could experience an adverse effect, such as injury or mortality. However,  
42 because of the overall low-to-moderate densities of juvenile white sturgeon expected in all pile  
43 driving locations, the relatively limited extent of area subject to underwater sound exceeding the  
44 effects threshold, and implementation of the avoidance and minimization measures included in

1 Mitigation Measures AQUA-1a and AQUA-1b, the potential for juvenile white sturgeon to experience  
2 an adverse effect from impact pile driving (e.g., injury or mortality) would be low.

### 3 ***Fish Stranding***

4 White sturgeon trapped within cofferdams or other fish exclusion structures would be at some risk  
5 for injury during fish removal activities. Because adults and juvenile white sturgeon could be  
6 present at any time during the year, some low risk of impact exists. Fish removal activities from  
7 construction areas would be implemented according to environmental commitment *Fish Rescue and*  
8 *Salvage Plan*, as described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
9 *Commitments*). Because of these measures, the risk of substantial effects would be minimized.

### 10 ***In-Water Work Activities***

11 As discussed for delta smelt (see Impact AQUA-1), in-water work activities have the potential  
12 disturb, injure or kill fish through direct physical injury from construction activities. Although most  
13 fish would likely avoid the noise and activity of pile installation and placement of riprap protection,  
14 these activities have the potential to affect fish. Primarily juvenile white sturgeon would be expected  
15 in the vicinity of the intake facilities and barge landings during construction, because adults are  
16 expected to more easily avoid these areas. Because of the relatively low densities of juvenile white  
17 sturgeon expected in all construction areas, the potential for effects would be somewhat limited.  
18 Furthermore, effects would be minimized by implementation of environmental commitments  
19 described in Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment Control*  
20 *Plan*; *Dispose of Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*.  
21 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

### 22 ***Loss of Spawning, Rearing, or Migration Habitat***

23 There is no suitable spawning habitat for white sturgeon in the vicinity of the proposed in-water  
24 work; therefore, white sturgeon spawning habitat would not be affected by construction activities.  
25 However, construction would temporarily and permanently affect migration and rearing habitat.  
26 Any activity that occurs in a species migration corridor has the potential to affect the behavior (i.e.,  
27 through a change in migration route within the channel, delay from a noise deterrent, artificial light  
28 sources, etc.). However, migration habitat would not be substantially affected by construction  
29 activities, as the majority of the work will be conducted within cofferdams, and ample migration  
30 habitat would be available in adjacent areas. The existing migration and rearing habitat is of  
31 relatively low quality, due to the armored levees with limited riparian vegetation. Because of the  
32 poor quality of the existing habitat, the overall effect of this habitat loss would be limited.

33 Implementation of *CM6 Channel Margin Enhancement* would enhance channel margin habitat along  
34 20 miles of the Sacramento River, including the vicinity of the intake structures, and would be  
35 designed to result in a net improvement in channel margin habitat function. Implementation of the  
36 environmental commitment *Barge Operations Plan* (see Impact AQUA-1 for delta smelt and  
37 Appendix 3B, *Environmental Commitments*) would limit the potential for impacts from vessel wakes  
38 and propeller wash on shoreline habitat.

39 The construction of the intakes and barge landings will temporarily affect white sturgeon migration  
40 and rearing habitat, and the intakes screens will permanently alter the nearshore portion of this  
41 habitat in the Sacramento River. Because of implementation of *CM6 Channel Margin Enhancement*,

1 the overall effects would be limited because of the relatively poor quality of the current habitat, and  
2 the addition of new, higher quality habitat associated with *CM6 Channel Margin Enhancement*.

### 3 **Predation**

4 Construction of in-water pilings and over-water structures and local temporary increases in  
5 turbidity associated with construction may affect predation on various fish species, including white  
6 sturgeon. In a laboratory study, prickly sculpin and northern pikeminnow have been observed to  
7 consume sturgeon larvae (Gadomski and Parsley 2005), and some degree of predation could occur  
8 on juveniles. However, due to the armored scutes (bony external scale) (French et al. 2010) and  
9 relatively rapid growth of sturgeon, predation would likely be low following the early life stages.  
10 Nobriga and Feyrer (2008) examined data for striped bass stomach contents collected between  
11 1963 and 2003, and did not find any sturgeon among the more than 4,000 samples. The increase in  
12 cover habitat for bass and other predatory fish that would be created at the barge landings would  
13 likely result in only a minimal effect on white sturgeon.

### 14 **Summary**

15 The potential for exposure of white sturgeon to construction-related activities is expected to be low.  
16 Implementation of environmental commitments *Environmental Training; Stormwater Pollution*  
17 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
18 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
19 *and Dredged Material* (see Appendix 3B, *Environmental Commitments*)—as well as the species'  
20 tolerance to turbidity—would minimize the effects of construction activities on turbidity, accidental  
21 spills, onsite and offsite sediment transport to surface waters, and re-suspension and redistribution  
22 of potentially contaminated sediments. Pertinent details of these plans are provided under Impact  
23 AQUA-1 for delta smelt. As a result, these effects would not likely be adverse to white sturgeon.

24 The moderate number of white sturgeon that would likely be present during the expected in-water  
25 work window would also limit the potential for white sturgeon to be injured or killed as a result of  
26 in-water construction activities. Impact pile driving could result in significant impacts on individual  
27 juvenile white sturgeon because they could be exposed to sound levels exceeding the interim  
28  $SEL_{cumulative}$  threshold. However, the numbers of fish affected by this level of noise would be  
29 relatively small, and pile driving would be limited to periods of relatively low fish abundance, and  
30 vibratory methods would be used whenever possible (avoiding the noise associated with impact pile  
31 driving). Implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity  
32 of these potential impacts. Implementation of Environmental Commitments *Fish Rescue and Salvage*  
33 *Plan and Barge Operations Plan* (as described in Appendix 3B) would also offset some potential  
34 effects of construction activities on white sturgeon. Construction of the approach canal and Byron  
35 Tract Forebay would not affect fish-accessible waterways and therefore would not affect white  
36 sturgeon. As a result, these construction activities would not be adverse.

37 Locally increased predator habitat and predation from the temporary construction structures  
38 (cofferdams and barge landing docks) would not have population level effects. Therefore, predation  
39 effects on white sturgeon from construction activities would not be adverse.

40 The effect of temporary and permanent rearing and migration habitat loss for white sturgeon would  
41 not be adverse due to the relatively small areas occupied by the construction and barge landing  
42 sites, the relatively low abundance of white sturgeon expected in the vicinity of these facilities  
43 during construction, and the low quality of the habitat affected by construction, as well as

1 implementation of environmental commitment *Barge Operations Plan* (see Impact AQUA-1 for delta  
2 smelt and Appendix 3B).

3 **NEPA Effects:** Overall, the potential effects of construction activities are not expected to adversely  
4 affect white sturgeon.

5 **CEQA Conclusion:** The potential for exposure of white sturgeon to construction-related activities is  
6 expected to be low. Implementation of environmental commitments *Environmental Training;*  
7 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
8 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils,*  
9 *Reusable Tunnel Material, and Dredged Material* (see Impact AQUA-1 for delta smelt and Appendix  
10 3B, *Environmental Commitments*) would reduce the amount of turbidity from in-water construction  
11 and would guide rapid and effective response in the case of inadvertent spills of hazardous  
12 materials. These measures—as well as the species' tolerance to turbidity—would minimize the  
13 effects of construction activities on turbidity, accidental spills, onsite and offsite sediment transport  
14 to surface waters, and re-suspension and redistribution of potentially contaminated sediments.

15 Although only a limited occurrence of white sturgeon is expected in the construction areas the direct  
16 effects of underwater construction noise on them would be a significant impact because of the high  
17 likelihood that it would cause injury or death to most impacted fish in the immediate vicinity of the  
18 activity. However, Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for  
19 effects from underwater noise and would reduce the severity of impacts to a less-than-significant  
20 level. Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge*  
21 *Operations Plan* (as described under Impact AQUA-1 for delta smelt and in Appendix 3B) would also  
22 minimize potential effects of construction activities on white sturgeon.

23 The limited susceptibility of sturgeon to predation and only locally increased predator habitat and  
24 predation from the temporary construction structures (cofferdams and barge landing docks) would  
25 not have population level effects. The effect of temporary and permanent rearing and migration  
26 habitat loss for white sturgeon would be limited due to the relatively small areas occupied by the  
27 construction and barge landing sites, and the low quality of the habitat affected by construction, as  
28 well as implementation of Environmental Commitment *Barge Operations Plan* (see Appendix 3B).  
29 Implementation of *CM6 Channel Margin Enhancement* would also result in a net improvement in  
30 channel margin habitat function. Based on the above the overall potential impacts of construction  
31 activities are expected to be less than significant, and no mitigation would be required.

32 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
33 **of Pile Driving and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

35 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
36 **and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

## 1 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

### 2 ***Temporary Increases in Turbidity***

3 As discussed for construction-related effects on turbidity (Impact AQUA-145), the potential  
4 increases in turbidity would be minimized to the extent possible through implementing the  
5 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
6 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
7 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
8 *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
9 *Material; Fish Rescue and Salvage Plan; and Barge Operations Plan).*

### 10 ***Accidental Spills***

11 Maintenance activities such as dredging, levee repair and placement of riprap could accidentally  
12 introduce contaminants into the aquatic environment. Effects would be minimized by implementing  
13 the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix  
14 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
15 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
16 *Containment, and Countermeasure Plan).* Implementation of the environmental commitments would  
17 reduce the likelihood of any significant contaminant input to the Sacramento River and potential  
18 effects on white sturgeon survival.

### 19 ***Underwater Noise***

20 As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
21 maintenance activities are not expected to reach a level that would harm juvenile or adult fishes.  
22 NMFS has found that underwater sound pressure levels less than the 150 dB RMS behavioral effects  
23 threshold may result in temporary altered behavior of fishes indicative of stress but would not  
24 result in permanent harm or injury (National Marine Fisheries Service 2001). Any increases in  
25 underwater noise would be temporary and infrequent, and would occur when the least number of  
26 white sturgeon are likely to be present.

### 27 ***Maintenance-Related Disturbance***

28 Direct injury and mortality of white sturgeon from the use of in-water equipment during  
29 maintenance are most likely to occur during dredging activities around the new intakes. Suction  
30 dredging and mechanical excavation can capture or crush fish, causing injury or mortality. White  
31 sturgeon are present year-round in the Sacramento River. Because sturgeon are benthic feeders,  
32 they may become entrained or injured by the dredge. However, potential effects would be  
33 minimized because maintenance dredging would occur infrequently, for a short duration, and in  
34 limited areas. Furthermore, effects would be minimized by implementation of environmental  
35 commitments including *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and*  
36 *Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
37 *Countermeasure Plan; and Barge Operations Plan,* described under Impact AQUA-1 for delta smelt  
38 and in Appendix 3B, *Environmental Commitments.*

### 39 ***Loss of Spawning, Rearing, or Migration Habitat***

40 White sturgeon habitat near the intake structures is limited to rearing and migration. A small area of  
41 rearing habitat (i.e., 600 m<sup>2</sup>) could be affected due to maintenance dredging. Dredging would

1 remove benthic macroinvertebrates that are consumed by white sturgeon. Migration habitat would  
2 be available farther out in the channel and would be unaffected by dredging or riprap placement.  
3 Rearing and migration habitat of similar quality would also be readily accessible to white sturgeon  
4 in the immediate area. Furthermore, potential effects would be minimized by implementation of  
5 environmental commitments described in Appendix 3B, *Environmental Commitments*. These  
6 environmental commitments include *Environmental Training; Stormwater Pollution Prevention Plan;*  
7 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
8 *Containment, and Countermeasure Plan; and Dispose of Spoils, Reusable Tunnel Material, and Dredged*  
9 *Material*. Pertinent details of these plans are provided under Impact AQUA-1.

#### 10 **Predation**

11 Maintenance activities would be unlikely to have any measurable effect on white sturgeon predation  
12 rates. These activities may include the use of barges and other watercraft that could theoretically  
13 provide cover, shelter, and perching areas for various predators. However, the limited duration of  
14 maintenance activities and the associated noise and disturbance would be expected to dissuade  
15 predators from concentrating at sufficient density to measurably affect predation rates on white  
16 sturgeon.

#### 17 **Summary**

18 White sturgeon are tolerant to increases in turbidity, which might occur during maintenance  
19 activities. Such activities would include maintenance dredging at the intake sites, and installation or  
20 repair of riprap bank armoring. Implementation of the environmental commitments described in  
21 Appendix 3B, *Environmental Commitments*, would further minimize or eliminate effects on white  
22 sturgeon by limiting turbidity increases, and by guiding the rapid and effective response in the case  
23 of inadvertent spills of hazardous materials. These Environmental Commitments are *Environmental*  
24 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
25 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of*  
26 *Spoils, Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans are provided  
27 under Impact AQUA-1 for delta smelt.

28 Implementation of these environmental commitments, along with the limited number of white  
29 sturgeon expected to occur in the maintenance areas during the expected in-water work windows,  
30 and the limited frequency and duration of in-water maintenance activities, would result in a very  
31 low potential for adverse effects on white sturgeon. In addition, no spawning habitat occurs in the  
32 areas potentially affected by maintenance activities, and ample rearing, and migration habitat of the  
33 same quality is readily accessible in the area, and this habitat would not be affected by maintenance  
34 activities.

35 **NEPA Effects:** As a result, the effects of short-term maintenance activities would not be adverse to  
36 white sturgeon.

37 **CEQA Conclusion:** White sturgeon are benthic fish that inhabit naturally turbid water and are not  
38 expected to be affected by temporary increases in turbidity during maintenance activities. In  
39 addition to the limited frequency and duration of in-water maintenance activities and  
40 implementation of environmental commitments identified above and described in detail under  
41 Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*, would minimize  
42 the potential for maintenance activities to affect white sturgeon by limiting turbidity increases, and  
43 by guiding the rapid and effective response in the case of inadvertent spills of hazardous materials.

1 These environmental commitments are *environmental Training; Stormwater Pollution Prevention*  
2 *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
3 *Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and*  
4 *Dredged Material*. Potential changes to habitat would also be limited and temporary.

5 In addition to being benthic dwellers, white sturgeon are present year-round in the Sacramento  
6 River, so they could potentially become entrained or injured by dredging equipment. Although the  
7 number of white sturgeon that could be affected by dredging is unknown, but expected to be low.  
8 Because maintenance dredging would occur infrequently, for a short duration, and in limited areas,  
9 in-water maintenance activities would not affect white sturgeon populations.

10 White sturgeon habitat near the intake structures is limited to rearing and migration, and similar  
11 habitat occurs in adjacent areas. Therefore, the limited extent of habitat disturbance expected from  
12 periodic maintenance activities is not expected to substantially decrease the available rearing and  
13 migration habitat in the area. Overall, the potential impacts of maintenance activities are considered  
14 less than significant because it would not reduce white sturgeon habitat, restrict its range, or  
15 interfere with its movement. Consequently, no mitigation would be required.

## 16 **Water Operations of CM1**

### 17 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

#### 18 ***Water Exports from SWP/CVP South Delta Facilities***

19 Alternative 1A would reduce the estimated total annual average salvage of white sturgeon at the  
20 combined SWP/CVP south Delta facilities by approximately 43% to 52%, compared to baseline  
21 scenarios. Total annual average salvage of juvenile white sturgeon at the SWP was estimated at 135–  
22 160 fish under baseline scenarios and just over 60 fish under the two Alternative 1A scenarios. At  
23 the CVP, baseline scenario annual salvage ranged from 110 to 130 white sturgeon, and Alternative  
24 1A scenario salvage was approximately 80 white sturgeon.

25 Reductions in salvage under Alternative 1A scenarios compared to baseline scenarios ranged from  
26 very little change in April–June (7 or fewer fish per month) to considerable changes in January–  
27 March (14–24 fewer fish, or ~95% reduction). The overall annual average reduction in salvage of  
28 juvenile white sturgeon from baseline scenarios to Alternative 1A scenarios is estimated at  
29 approximately 100–150 fish (42–50% reduction).

30 Overall, salvage of white sturgeon juveniles is estimated to be considerably lower in drier years than  
31 wetter years. The SWP salvage estimates indicate peaks in December, April–May, and August under  
32 all model scenarios; with similar values between scenarios for most months except April–May, when  
33 Alternative 1A scenarios had higher values. Salvage is estimated to peak in February–April and July–  
34 August at the CVP facility under all model scenarios. Total annual average salvage of juvenile white  
35 sturgeon at SWP was estimated to be similar among all scenarios at 21–27 fish per year. At the CVP,  
36 baseline scenario total annual salvage ranged from 12 to 14 white sturgeon, and Alternative 1A  
37 scenario salvage was 8–9 white sturgeon.

38 Under the assumption that reduced export pumping in the south Delta is directly proportional to  
39 entrainment of juvenile white sturgeon, entrainment should decrease under Alternative 1A relative  
40 to NAA. The decrease would be greater in wet and above-normal years (40–60%) than in below-  
41 normal, dry, and critical years (10–30% or less).

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 Similar to discussion for green sturgeon (see Impact AQUA-129), entrainment losses of white  
3 sturgeon is expected to be minimized by screen designs at the north Delta intake facilities, which  
4 will be designed and built to specifications that are developed to reduce the entrainment and  
5 impingement of covered fish species. Exceptions could occur for smaller larvae that may occur in the  
6 intake vicinity. Entrainment of larval fish by water diversions in the south Delta are highly variable,  
7 ranging from zero to an estimated 10,000 individuals for at least one of the facilities between 1981  
8 and 2006 (Israel et al. 2009). Very little is known of the larval densities in the north Delta area, so  
9 entrainment and impingement monitoring will determine the extent to which they are present. The  
10 projects adaptive management plan includes monitoring of the new screens to determine their  
11 effectiveness and if they are not meeting expectations additional measures may be implemented to  
12 improve screen performance. These measures may include modifications to the screens or other  
13 structural components at the intakes, or changes in water diversion operations to reduce  
14 entrainment or impingement rates of juvenile white sturgeon.

15 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

16 Entrainment of white sturgeon at the North Bay Aqueduct has not been explicitly analyzed.  
17 However, the Barker Slough Pumping Plant is screened for fish >25mm and the alternative intake  
18 would presumably have screens of 1.75-m mesh and therefore it would exclude white sturgeon >10  
19 mm based on north Delta intake analysis (as evaluated in *BDCP Effects Analysis – Appendix 5B,*  
20 *Entrainment, Section B.5.9.2.1 Screening Effectiveness Analysis, hereby incorporated by reference*).  
21 Overall effects would be expected to be no greater than for delta smelt.

22 If unforeseen changes in distributions or other factors occur as a result of project operations that  
23 would increase proportional loss of white sturgeon to entrainment, monitoring and the BDCP-  
24 proposed Real-Time Response Team would implement measures to avoid or minimize any potential  
25 threats to the species that might occur. Based on the current analysis, this would not be necessary.

26 **NEPA Effects:** Based on the projected entrainment of white sturgeon under the BDCP, a reduction is  
27 expected at the south Delta facilities. However, the potential entrainment of larval sturgeon at the  
28 north Delta facility raises some uncertainty of the overall change in entrainment rate. This  
29 uncertainty will be addressed through monitoring and adaptive management actions. Based on  
30 available information, overall entrainment effects on white sturgeon populations are not expected to  
31 substantially change under Alternative 1A. These effects would likely not be adverse.

32 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
33 south SWP/CVP facilities are expected to result in a slight decrease in entrainment of white  
34 sturgeon. However, operational activities associated with water exports from SWP/CVP north Delta  
35 intake facilities could result in an increase in entrainment or a loss of individual sturgeon at that  
36 location. Monitoring and adaptive management protocols will be implemented to confirm that fish  
37 are being excluded from entrainment and impingement in the manner that the design specifications  
38 suggest. Overall, the impacts of water operations on white sturgeon would be less than significant  
39 because they would not reduce their numbers. Consequently, no mitigation would be required.

**Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon**

In general, Alternative 1A would not affect spawning and egg incubation habitat for white sturgeon relative to NAA.

**Sacramento River**

Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to May spawning and egg incubation period for white sturgeon. Flows under A1A\_LLT would typically be similar to or greater than flows under NAA during February to May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A1A\_LLT would be similar to those under NAA during all water year types in February and March, and generally greater than NAA flows in April and May, with one exception in April during wet water years with a small decrease of 7%. These results indicate either no effect or a slight beneficial effect from increased flows, depending on month and water year type, compared to NAA.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A in any month or water year type throughout the period.

The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year of the 82-year modeling period (Table 11-1A-11). The combination of number of days and degrees above each threshold were further assigned a “level of concern”, as defined in Table 11-1A-12. Differences between baselines and Alternative 1A in the highest level of concern across all months and all 82 modeled years are presented in Table 11-1A-66. For the 61°F threshold, there would be 17 fewer (43% fewer) “red” years under Alternative 1A than under NAA. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between NAA and Alternative 1A.

**Table 11-1A-66. Differences between Baseline and Alternative 1A Scenarios in the Number of Years in Which Water Temperature Exceedances above the 61°F and 68°F Thresholds Are within Each Level of Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>61°F threshold</b>		
Red	32 (178%)	-17 (-43%)
Orange	1 (17%)	4 (25%)
Yellow	-15 (125%)	6 (38%)
None	-18 (150%)	7 (70%)
<b>68°F threshold</b>		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	1 (NA)	-2 (-200%)
None	-1 (-1%)	2 (2%)

NA = could not be calculated because the denominator was 0.

31

1 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
 2 Hamilton City during March through June (Table 11-1A-67, Table 11-1A-68). Total degree-days  
 3 exceeding the 61°F threshold under Alternative 1A would be 31% higher than those under NAA  
 4 during March, although this is an increase of only 5 degree-days, which would not cause biologically  
 5 meaningful effect to white sturgeon. During April through June, total degree days exceeding the  
 6 threshold would be 17% to 23% lower than those under NAA. Total degree-days exceeding the 68°F  
 7 threshold would not differ between NAA and Alternative 1A during March and April, but would be  
 8 29% to 36% lower under Alternative 1A than under NAA during May and June.

9 **Table 11-1A-67. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Days**  
 10 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the**  
 11 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LL1	NAA vs. A1A_LL1
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	9 (NA)	5 (125%)
	Dry	11 (NA)	0 (0%)
	Critical	1 (NA)	0 (0%)
	All	21 (NA)	5 (31%)
April	Wet	65 (542%)	-1 (-1%)
	Above Normal	60 (600%)	-8 (-10%)
	Below Normal	62 (1,033%)	0 (0%)
	Dry	53 (104%)	-91 (-47%)
	Critical	15 (1,500%)	1 (7%)
	All	255 (319%)	-99 (-23%)
May	Wet	857 (257%)	-258 (-18%)
	Above Normal	206 (94%)	-145 (-25%)
	Below Normal	389 (211%)	-60 (-9%)
	Dry	175 (87%)	-258 (-41%)
	Critical	340 (168%)	-10 (-2%)
	All	1,967 (173%)	-731 (-19%)
June	Wet	435 (75%)	-523 (-34%)
	Above Normal	112 (37%)	-254 (-38%)
	Below Normal	473 (224%)	-29 (-4%)
	Dry	649 (194%)	-53 (-5%)
	Critical	555 (148%)	9 (1%)
	All	2,224 (123%)	-850 (-17%)

NA = could not be calculated because the denominator was 0.

12

1 **Table 11-1A-68. Differences between Baseline and Alternative 1A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the**  
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
April	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
May	Wet	31 (443%)	-5 (-12%)
	Above Normal	2 (NA)	-18 (-90%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	-2 (-100%)
	Critical	2 (NA)	1 (100%)
	All	35 (500%)	-24 (-36%)
June	Wet	3 (NA)	-5 (-63%)
	Above Normal	2 (200%)	-2 (-40%)
	Below Normal	4 (NA)	2 (100%)
	Dry	0 (NA)	0 (NA)
	Critical	20 (NA)	-7 (-26%)
	All	29 (2,900%)	-12 (-29%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
 7 during February to May, flows under A1A\_LLT would be similar to or up to 110% greater than flows  
 8 under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results  
 9 indicate that there would be mostly beneficial flow-related effects of Alternative 1A on white  
 10 sturgeon spawning and egg incubation in the Feather River.

11 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
 12 confluence with the Sacramento River were examined during the February through May white  
 13 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ  
 14 between NAA and Alternative 1A at either location throughout the period.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis under Alternative 1A during February through May would  
3 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4 *Analysis*).

5 Water temperature modeling was not conducted for the San Joaquin River.

6 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not  
7 have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 1A  
8 are generally similar or greater than flows under NAA in all rivers. In addition, water temperatures  
9 and exceedances above NMFS temperature thresholds for spawning adults and egg incubation  
10 under Alternative 1A would generally be similar to or lower than exceedances under NAA.

11 **CEQA Conclusion:**

12 In general, under Alternative 1A water operations, the quantity and quality of spawning and egg  
13 incubation habitat for white sturgeon would not be affected relative to the CEQA baseline.

14 **Sacramento River**

15 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
16 May spawning and egg incubation period for white sturgeon. Flows at Wilkins Slough under  
17 A1A\_LL1T would generally be similar to or greater than flows under Existing Conditions with few  
18 exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
19 Flows at Verona under A1A\_LL1T would generally be similar to those under Existing Conditions  
20 except in below normal years in February and March in which flows would be up to 7% lower. Flows  
21 would also be lower in wet years in April (8%) and May (18%), and in above normal years in April  
22 (6%). These results indicate that there would be some limited reductions in flows in the Sacramento  
23 River during this period under Alternative 1A compared to Existing Conditions.

24 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
25 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
26 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
27 be no differences (<5%) in mean monthly water temperature between Existing Conditions and  
28 Alternative 1A in any month or water year type throughout the period.

29 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
30 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
31 of the 82-year modeling period (Table 11-1A-11). The combination of number of days and degrees  
32 above each threshold were further assigned a “level of concern”, as defined in Table 11-1A-12.  
33 Differences between baselines and Alternative 1A in the highest level of concern across all months  
34 and all 82 modeled years are presented in Table 11-1A-66. For the 61°F threshold, there would be  
35 32 more (178% increase) “red” years under Alternative 1A than under Existing Conditions. For the  
36 68°F threshold, there would be negligible differences in the number of years under each level of  
37 concern between Existing Conditions and Alternative 1A.

38 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
39 Hamilton City during March through June (Table 11-1A-67, Table 11-1A-68). Total degree-days  
40 exceeding the 61°F threshold under Alternative 1A would be 21 degree-days (percent change unable  
41 to be calculated due to division by 0) to 2224 degree-days (123%) higher depending on month.  
42 Total degree-days exceeding the 68°F threshold would not differ between NAA and Alternative 1A

1 during March and April. During May and June, total degree-days would be 35 (500%) and 29  
2 (2900%) degree-days higher under Alternative 1A, although these small absolute differences would  
3 not cause a biologically meaningful effect on white sturgeon.

#### 4 **Feather River**

5 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
6 during February to May, flows under A1A\_LL1T would generally be similar to or greater than those  
7 under Existing Conditions, except for below normal years in February and March and during wet  
8 years in May, in which flows would be up to 28% lower depending on location (Appendix 11C,  
9 *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be very  
10 few reductions in flows in the Feather River under Alternative 1A.

11 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
12 confluence with the Sacramento River were examined during the February through May white  
13 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality  
14 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
15 temperatures would not differ between NAA and Alternative 1A at either location throughout the  
16 period, except below Thermalito Afterbay during February, in which temperatures under  
17 Alternative 1A would be 6% higher than temperatures under Existing Conditions.

#### 18 **San Joaquin River**

19 Flows in the San Joaquin River under Alternative 1A would be similar to flows under Existing  
20 Conditions during February and up to 43% lower during March through July.

21 Water temperatures were not modeled for the San Joaquin River.

#### 22 **Summary of CEQA Conclusion**

23 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between  
24 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
25 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA  
26 conclusion set forth above. Flows in the Sacramento and Feather rivers would generally be similar  
27 between Alternative 1A and Existing Conditions. However, water temperatures and exceedances  
28 above NMFS temperature thresholds in the Sacramento River would be greater under Alternative  
29 1A relative to Existing Conditions. There would be small to moderate decreases in flows during most  
30 of the spawning and egg incubation period in the San Joaquin River.

31 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
32 change, future water demands, and implementation of the alternative. The analysis described above  
33 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
34 the alternative from those of sea level rise, climate change and future water demands using the  
35 model simulation results presented in this chapter. However, the increment of change attributable  
36 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
37 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
38 implementation period, which does include future sea level rise, climate change, and water  
39 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
40 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
41 effect of the alternative from those of sea level rise, climate change, and water demands.

1 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
2 term implementation period and Alternative 1A indicates that flows in the locations and during the  
3 months analyzed above would generally be similar between Existing Conditions during the LLT and  
4 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
5 found above would generally be due to climate change, sea level rise, and future demand, and not  
6 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
7 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
8 result in a significant impact on spawning and egg incubation habitat for white sturgeon. This  
9 impact is found to be less than significant and no mitigation is required.

#### 10 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

11 In general, Alternative 1A would not affect the quantity and quality of white sturgeon larval and  
12 juvenile rearing habitat relative to NAA.

13 Water temperature was used to determine the potential effects of Alternative 1A on white sturgeon  
14 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
15 their habitat is more likely to be limited by changes in water temperature than flow rates.

16 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
17 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water  
18 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
19 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A in  
20 any month or water year type throughout the period, except for a 5% higher mean monthly  
21 temperature in wet years during September under Alternative 1A.

22 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
23 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality  
24 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
25 differences (<5%) in mean monthly water temperature between NAA and Alternative 1A in any  
26 month or water year type throughout the period

27 Water temperatures were not modeled in the San Joaquin River.

28 **NEPA Effects:** These results indicate that the effect is not adverse because it does not have the  
29 potential to substantially reduce the amount of suitable habitat. There would be no differences in  
30 water temperatures between Alternative 1A and NAA in the Sacramento and Feather Rivers.

31 **CEQA Conclusion:** In general, Alternative 1A would not affect the quantity and quality of white  
32 sturgeon larval and juvenile rearing habitat relative to the Existing Conditions.

33 Water temperature was used to determine the potential effects of Alternative 1A on white sturgeon  
34 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
35 their habitat is more likely to be limited by changes in water temperature than flow rates.

36 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
37 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water  
38 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
39 monthly water temperatures would be similar between Existing Conditions and Alternative 1A  
40 during October through July, but 7% lower under Alternative 1A relative to Existing Conditions  
41 during August and September.

1 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
2 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality*  
3 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
4 temperatures would be similar between Existing Conditions during March through June and  
5 September, but 5% to 8% higher under Alternative 1A relative to Existing Conditions during July  
6 through August and October through February.

7 Water temperatures were not modeled in the San Joaquin River.

### 8 **Summary of CEQA Conclusion**

9 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between  
10 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
11 alternative could substantially reduce the quantity and quality of suitable rearing habitat, contrary  
12 to the NEPA conclusion set forth above. There would be effect of Alternative 1A on temperatures in  
13 the Sacramento River. There would be small, but persistent increases in temperatures in the Feather  
14 River during a substantial portion of the rearing period.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
16 change, future water demands, and implementation of the alternative. The analysis described above  
17 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
18 the alternative from those of sea level rise, climate change and future water demands using the  
19 model simulation results presented in this chapter. However, the increment of change attributable  
20 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
21 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
22 implementation period, which does include future sea level rise, climate change, and water  
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
27 term implementation period and Alternative 1A indicates that flows in the locations and during the  
28 months analyzed above would generally be similar between Existing Conditions during the LLT and  
29 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
30 found above would generally be due to climate change, sea level rise, and future demand, and not  
31 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
33 result in a significant impact on rearing habitat for white sturgeon. This impact is found to be less  
34 than significant and no mitigation is required.

### 35 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

36 In general, the effects of Alternative 1A on white sturgeon migration conditions relative to NAA are  
37 uncertain.

38 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins  
39 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number  
40 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)  
41 (Table 11-1A-69). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A1A\_LL1T were  
42 similar to those under NAA. The number of months per year above 31,000 cfs at Verona would be

1 lower for all water year types (up to 50% lower) relative to NAA depending on water year type,  
2 except above normal years (6% increase). However, on an absolute scale, none of these differences  
3 would be biologically meaningful to white sturgeon (up to 0.2 months). Overall, there is no  
4 consistent difference between Alternative 1A and NAA.

5 **Table 11-1A-69. Difference and Percent Difference in Number of Months between February and**  
6 **May in Which Flow Rates Exceed 17,700 and 5,300 Cubic Feet per Second (cfs) in the Sacramento**  
7 **River at Wilkins Slough and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>Wilkins Slough, 17,700 cfs<sup>a</sup></b>		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (5%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
<b>Wilkins Slough, 5,300 cfs<sup>b</sup></b>		
Wet	-0.1 (-1%)	0.1 (2%)
Above Normal	-0.1 (-1%)	0.3 (4%)
Below Normal	0.1 (3%)	0.4 (9%)
Dry	0.6 (13%)	0.3 (6%)
Critical	0.3 (10%)	0.3 (7%)
<b>Verona, 31,000 cfs<sup>a</sup></b>		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.1 (-5%)	0.1 (6%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.2 (-60%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Months analyzed: February through May.

<sup>b</sup> Months analyzed: November through May.

8

9 Larval transport flows were also examined by utilizing the positive correlation between year class  
10 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the  
11 mechanism responsible for the relationship is that Delta outflow provides improved larval transport  
12 that results in improved year class strength. The percent of months exceeding flow thresholds under  
13 A1A\_LLT would be lower than those under NAA (up to 67%) (Table 11-1A-70). These results  
14 indicate that, using the positive correlation between Delta outflow and year class strength, year class  
15 strength would be lower under Alternative 1A.

1 **Table 11-1A-70. Difference and Percent Difference in Percentage of Months in Which Average**  
 2 **Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in**  
 3 **April and May of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
<b>April</b>			
15,000 cfs	Wet	-15 (-16%)	-15 (-16%)
	Above Normal	-25 (-27%)	-25 (-27%)
20,000 cfs	Wet	-12 (-14%)	-12 (-14%)
	Above Normal	-33 (-44%)	-25 (-38%)
25,000 cfs	Wet	-15 (-19%)	-12 (-15%)
	Above Normal	-17 (-29%)	-8 (-17%)
<b>May</b>			
15,000 cfs	Wet	-15 (-17%)	-8 (-10%)
	Above Normal	-33 (-40%)	-8 (-14%)
20,000 cfs	Wet	-38 (-45%)	-15 (-25%)
	Above Normal	-25 (-60%)	-17 (-50%)
25,000 cfs	Wet	-31 (-44%)	-19 (-33%)
	Above Normal	-25 (-75%)	-17 (-67%)
<b>April/May Average</b>			
15,000 cfs	Wet	-15 (-16%)	-8 (-9%)
	Above Normal	-33 (-33%)	-25 (-27%)
20,000 cfs	Wet	-23 (-26%)	-19 (-23%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-25 (-50%)	-25 (-50%)

4  
 5 For juveniles, year-round migration flows at Verona were up to 55% lower under A1A\_LLT relative  
 6 to NAA during July through September and November (Appendix 11C, *CALSIM II Model Results*  
 7 *utilized in the Fish Analysis*). Migration flows during other months were typically similar of greater  
 8 than NAA, with few exceptions in some months or water years.

9 For adults, the average number of months per year during the November through May adult  
 10 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was  
 11 determined (Table 11-1A-69). The average number of months exceeding 5,300 cfs under A1A\_LLT  
 12 would be similar to the number of months under NAA in wet and above normal years and higher in  
 13 remaining water year types (6% to 9% higher). These increase in exceedances are considered small  
 14 (<15%) and would not likely affect white sturgeon adult migration.

15 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 1A and  
 16 NAA (Table 11-1A-69). However, due to the removal of water at the north Delta intakes, there are  
 17 substantial differences in through-Delta flows between Alternative 1A and NAA (Table 11-1A-70).  
 18 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between  
 19 year class strength and Delta outflow during April and May. However, this conclusion was reached in  
 20 the absence of north Delta intakes and the exact mechanism that causes this correlation is not  
 21 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper

1 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another  
2 hypothesis suggests that the positive correlation is a result of higher flows through the Delta  
3 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some  
4 combination of these factors are working together to produce the positive correlation between high  
5 flows and sturgeon year-class strength.

6 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation  
7 between year class strength and river/Delta flow will be addressed through targeted research and  
8 monitoring to be conducted in the years leading up to the initiation of north Delta facilities  
9 operations. If these targeted investigations determine that the primary mechanisms behind the  
10 positive correlation between high flows and sturgeon year-class strength are related to upstream  
11 conditions, then Alternative 1A would be deemed Not Adverse due to the similarities in upstream  
12 flow conditions between Alternative 1A and NAA. However, if the targeted investigations lead to a  
13 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and  
14 through-Delta flow conditions, then Alternative 1A would be deemed Adverse due to the magnitude  
15 of reductions in through-Delta flow conditions in Alternative 1A as compared to NAA.

16 **CEQA Conclusion:** In general, under Alternative 1A water operation, migration conditions for white  
17 sturgeon would be similar to those under the CEQA baseline.

18 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough  
19 under A1A\_LLT would be similar to those under Existing Conditions in wet, dry, and critical years  
20 (Table 11-1A-69). The number of months per year above 17,000 cfs at Wilkins Slough under  
21 A1A\_LLT would be 18% greater than under Existing Conditions in above normal years and 25%  
22 lower than under Existing Conditions in below normal water years. The number of months per year  
23 above 31,000 cfs at Verona would range from a reduction of 0.1 months (5% reduction in above  
24 normal years) to a decrease of 0.2 months (60% lower in dry years) relative to Existing Conditions  
25 depending on water year type.

26 For Delta outflow, the percent of months exceeding flow thresholds under A1A\_LLT would  
27 consistently be lower than those under Existing Conditions for each flow threshold, water year type,  
28 and month (16% to 75% lower on a relative scale) (Table 11-1A-70).

29 For juveniles, year-round migration flows at Verona would be up to 35% lower under A1A\_LLT  
30 relative to Existing Conditions during July through September and November (Appendix 11C,  
31 *CALSIM II Model Results utilized in the Fish Analysis*). Migration flows during other months were  
32 typically similar of greater than Existing Conditions, with few exceptions in some months or water  
33 years.

34 For adult migration, the average number of months exceeding 5,300 cfs under A1A\_LLT would  
35 generally be similar to the number of months under Existing Conditions, except in dry (13% greater)  
36 and critical water years (10% greater) (Table 11-1A-69).

### 37 **Summary of CEQA Conclusion**

38 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between  
39 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
40 alternative could substantially reduce migration conditions for green sturgeon, contrary to the  
41 NEPA conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for  
42 Delta outflow would be lower under Alternative 1A than under Existing Conditions, although there  
43 is high uncertainty that year class strength is due to Delta outflow or if both year class strength and

1 Delta outflows co-vary with another unknown factor. There are increases and decreases in  
2 exceedances above flow thresholds in the Sacramento River under Alternative 1A relative to  
3 Existing Conditions and reductions in juvenile migration flows in the Sacramento River. These  
4 reduced flows would have a substantial effect on the ability to migrate downstream, delaying or  
5 slowing rates of successful migration downstream and increasing the risk of mortality.

6 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
7 change, future water demands, and implementation of the alternative. The analysis described above  
8 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
9 the alternative from those of sea level rise, climate change and future water demands using the  
10 model simulation results presented in this chapter. However, the increment of change attributable  
11 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
12 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
13 implementation period, which does include future sea level rise, climate change, and water  
14 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
15 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
16 effect of the alternative from those of sea level rise, climate change, and water demands.

17 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
18 term implementation period and Alternative 1A indicates that flows in the locations and during the  
19 months analyzed above would generally be similar between Existing Conditions during the LLT and  
20 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
21 found above would generally be due to climate change, sea level rise, and future demand, and not  
22 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
23 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would  
24 not in itself result in a significant impact on migration conditions for white sturgeon. Additionally, as  
25 described above in the NEPA Effects statement, further investigation is needed to better understand  
26 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management  
27 would be used to make adjustments to meet the biological goals and objectives. This impact is found  
28 to be less than significant and no mitigation is required.

## 29 **Restoration Measures (CM2, CM4–CM7, and CM10)**

### 30 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

#### 31 ***Temporary Increases in Turbidity***

32 Restoration construction activities such as riprap removal, shoreline excavation and re-contouring,  
33 and planting riparian vegetation have the potential to result in temporary increases in turbidity  
34 conditions in adjacent waterways. However, white sturgeon inhabit naturally turbid water and are  
35 unlikely to be affected by temporary increases in turbidity during restoration construction.  
36 Implementing the environmental commitments described under Impact AQUA-1 for delta smelt and  
37 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
38 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
39 *Prevention, Containment, and Countermeasure Plan; Fish Rescue and Salvage Plan; and Barge*  
40 *Operations Plan)*, would minimize the potential for turbidity to affect white sturgeon.

1       **Increased Exposure to Mercury**

2       As discussed above for delta smelt (Impact AQUA-7), the implementation of *CM12 Methylmercury*  
3       *Management* would minimize potential effects of methylmercury mobilization from restoration  
4       sites, on white sturgeon. As a result, restoration activities are not likely to produce the  
5       biogeochemical conditions that would support methylation of mercury; thus increased  
6       bioavailability and toxicity as a result of restoration activities are not expected. However, the cycling  
7       of mercury is a complicated process, and is difficult to predict based on existing information.

8       **Accidental Spills**

9       As discussed above for construction and maintenance activities (see Impact AQUA-1 and Impact  
10       AQUA-2 for delta smelt), implementation of the environmental commitments described in Appendix  
11       3B, *Environmental Commitments*, would minimize the potential for introduction of contaminants to  
12       surface waters and provide for effective containment and cleanup should accidental spills occur.  
13       These environmental commitments are *Environmental Training; Stormwater Pollution Prevention*  
14       *Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
15       *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
16       *Material; and Barge Operations Plan*. Specifically, the *Spill Prevention, Containment, and*  
17       *Countermeasure Plan* will be implemented to minimize the risk of spills occurring and to provide for  
18       rapid and effective response to contain any accidental spills.

19       **Disturbance of Contaminated Sediments**

20       Runoff and resuspension of contaminants could cause short-term, localized increases in the  
21       concentrations of contaminants in and near restoration sites (see discussion for delta smelt under  
22       Impact AQUA-7). Sturgeon typically feed on prey items that are associated with the substrate, and  
23       are prone to exposure to sediment borne toxicants. They also tend to bioaccumulate toxicants that  
24       occur in the Plan Area, such as methylmercury, pesticides and selenium, and spend several years  
25       rearing in the Plan Area. As a result, they have an increased risk of effects from disturbances of  
26       contaminated sediments. Adhering to the expected in-water construction window would provide  
27       limited protection for sturgeon, because juvenile sturgeon can occur in the Plan Area throughout the  
28       year. Although juvenile sturgeon could be present during the in-water work window, the limited  
29       frequency, duration, and spatial extent of in-water restoration activities and implementation of  
30       appropriate environmental commitments (see Appendix 3B; *Environmental Training; Stormwater*  
31       *Pollution Prevention Plan; Erosion and Sediment Control Plan; Disposal of Spoils, Reusable Tunnel*  
32       *Material, and Dredged Material; and Barge Operations Plan*) would minimize exposure levels.  
33       Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt. Because of the  
34       temporary nature of toxicity spikes, the potential effects would be minimized.

35       **In-Water Work Activities**

36       Restoration construction activities such as equipment mobilization, development of staging areas,  
37       and dry levee preparation could temporarily produce noise levels that penetrate ground soils and  
38       affect nearby fishes. Such activities are not expected to elevate underwater noise above the  
39       threshold sound pressure levels established for fish (see discussion for delta smelt under Impact  
40       AQUA-1). Any changes in disturbance levels would be minor and temporary, and fish are expected to  
41       generally avoid areas where shoreline construction activities are occurring. Potential effects of in-  
42       water activity would be minimized by implementation of the environmental commitments  
43       described under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*, including

1 *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material;*  
2 *and Barge Operations Plan.* Pertinent details of these plans are provided under Impact AQUA-1 for  
3 delta smelt.

#### 4 **Predation**

5 The creation of permanent tidal brackish habitat within Suisun Marsh would create permanent year-  
6 round rearing habitat for juvenile white sturgeon. Once these habitats became fully established they  
7 are expected to provide highly productive food and refuge habitats. Due to their salinities, these  
8 habitats would be expected to provide some refuge from black bass. Also since younger juvenile  
9 sturgeon are less tolerant of saltwater, juveniles that occupy these brackish habitats are likely larger  
10 and have developed armored bony plating to substantially reduce predation vulnerability.

#### 11 **Summary**

12 In-water and shoreline construction activities associated with habitat restoration would be  
13 scheduled to occur when the least number of white sturgeon would be present in or near the  
14 restoration sites. Such activities would include riprap removal and levee breaching, and shoreline  
15 excavation and re-contouring. In addition, runoff from upland construction areas would also have  
16 the potential to affect aquatic habitats and white sturgeon. White sturgeon would likely tolerate the  
17 increases in turbidity which might occur during shoreline restoration construction activities.  
18 Implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
19 and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
20 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
21 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
22 *and Dredged Material)*, would minimize or eliminate effects on white sturgeon (see Impact AQUA-7).  
23 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

24 While implementation of these environmental commitments would minimize or eliminate short-  
25 term effects occurring during restoration construction, long-term effects could also occur. For  
26 example, removing or breaching levees would result in the expansion of floodplain habitat, and  
27 more frequent inundation these areas, potentially promoting conversion of mercury to methylated  
28 mercury, and runoff containing agricultural-related toxins such as copper and organochlorine  
29 pesticides. However, the overall effect of increased bioavailability of methylmercury and other  
30 pollutants on white sturgeon is likely to be of low magnitude, periodic and localized. In addition,  
31 potential increases would be minimized to the extent possible because of implementation of *CM12*  
32 *Methylmercury Management* (see Impact AQUA-10).

33 **NEPA Effects:** For these reasons, white sturgeon would not be adversely affected by restoration  
34 construction activities.

35 **CEQA Conclusion:** White sturgeon inhabit naturally turbid water and are not expected to be affected  
36 by temporary increases in turbidity during restoration construction activities. In addition to the  
37 limited frequency and duration and spatial extent of in-water restoration activities and  
38 implementation of environmental commitments identified above and described in detail under  
39 Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments (Environmental*  
40 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
41 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of*  
42 *Spoils, Reusable Tunnel Material, and Dredged Material)*, would minimize the potential for turbidity,  
43 accidental spills, resuspension of contaminated sediments, or construction noise to affect white

1 sturgeon. Therefore, this impact is considered less than significant for white sturgeon because it  
2 would not substantially reduce habitat, restrict its range or interfere with its movement.  
3 Consequently, no mitigation would be required.

#### 4 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 5 **Sturgeon**

6 Effects of contaminants on white sturgeon would be similar to those described for green sturgeon  
7 under AQUA-134. While white sturgeon are less sensitive than green sturgeon to selenium  
8 contamination, white sturgeon are a resident species and could have more prolonged exposure to  
9 San Joaquin River selenium concentrations.

10 **NEPA Effects:** While Alternative 1A actions are likely to result in increased production, mobilization,  
11 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system, any  
12 such releases would typically be short-term and localized, and would be unlikely to result in  
13 measurable increases in the bioaccumulation in white sturgeon. Although white sturgeon are known  
14 to bioaccumulate selenium due in large part to their consumption of the overbite clam (*C.*  
15 *amurensis*), habitat restoration measures under Alternative 1A are expected to have little effect on  
16 selenium bioaccumulation in the Plan Area. Overall, the effects of contaminants associated with  
17 restoration measures would not be adverse for white sturgeon with respect to copper, ammonia and  
18 pesticides. The effects of methylmercury and selenium on white sturgeon are uncertain.

19 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
20 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
21 However, such releases would typically be short-term and localized, and would be unlikely to result  
22 in measurable increases in the bioaccumulation in white sturgeon. For selenium, evaluation of the  
23 factors that influence its bioavailability and bioaccumulation indicate a low probability for effects.  
24 For methylmercury, implementation of *CM12 Methylmercury Management* would help to minimize  
25 the increased mobilization of methylmercury at restoration areas. Therefore, the impact of  
26 contaminants is considered less than significant because it would not substantially effect white  
27 sturgeon either directly or through habitat modifications and, with restoration, would be beneficial  
28 in the long-term. Consequently, no mitigation would be required.

29 In addition, implementation of *CM12 Methylmercury Management* would help to minimize the  
30 increased mobilization of methylmercury at restoration areas. In addition, the overall effects  
31 associated with habitat restoration are expected to result in an overall benefit to white sturgeon.

#### 32 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

33 For discussion of the potential effects of restored habitat conditions on white sturgeon, see the  
34 discussion under Impact AQUA-9 for delta smelt.

#### 35 **CM2 Yolo Bypass Fisheries Enhancement**

36 As discussed under Impact AQUA-9, Yolo Bypass fisheries enhancement modifications are designed  
37 to increase the frequency, duration and magnitude of seasonal floodplain inundation in the Yolo  
38 Bypass. These actions would improve passage and habitat conditions for white sturgeon. These  
39 modifications, which include fish passage improvements and flow management, would reduce  
40 migratory delays and loss of adult sturgeon at Fremont Weir and other structures. The Yolo Bypass

1 would potentially provide temporary habitat for white sturgeon but would not be a substantial  
2 benefit.

### 3 ***CM4 Tidal Natural Communities Restoration***

4 For discussion of the potential effects of *CM4 Tidal Natural Communities Restoration* on white  
5 sturgeon, see the discussion under Impact AQUA-9. Although tidal habitat restoration would benefit  
6 white sturgeon, habitat conditions are likely to decrease for larval and juvenile sturgeon over time,  
7 because of temperature effects associated with climate change during the late spring. It is  
8 anticipated that the overall effect of *CM4 Tidal Natural Communities Restoration* would remain  
9 positive because increases in habitat quantity could increase overall productivity and survival,  
10 providing a potential mechanism to at least partially offset the future effects of climate change (see  
11 Impact AQUA-9).

12 As discussed under Impact AQUA-9, increased food productivity is expected in all ROAs as a result of  
13 the BDCP, but the Suisun Marsh, Cache Slough, and South Delta ROAs are expected to see the  
14 greatest increases in productivity. Sturgeon feed on benthic invertebrates, including those found on  
15 marsh mudflats, which will benefit from the transfer of increased production to mudflat fauna in  
16 restored marshes. Therefore, the substantial increase in these habitats would likely increase total  
17 food availability for sturgeon. While white sturgeon are not expected to extensively use floodplain or  
18 floodplain wetland habitat, potential increases in food resources from seasonal inundation of these  
19 habitats is considered beneficial to the species. For further discussion see Impact AQUA-9.

### 20 ***CM5 Seasonally Inundated Floodplain Restoration***

21 While white sturgeon are not expected to extensively use floodplain habitat, periodic inundation of  
22 the restored floodplain also will benefit sturgeon by cycling nutrients, supporting growth of  
23 plankton and aquatic insects. Providing river–floodplain connectivity would increase production of  
24 lower trophic levels at relatively rapid time scales, with some food web organisms responding  
25 within days at high densities.

26 Although food is not likely a limiting factor to the abundance of sturgeon in the Delta, BDCP actions,  
27 notably the restoration and enhancement of upstream habitats, may increase sturgeon food  
28 availability relative to Existing Conditions. If the upstream productivity transfer occurs at the  
29 planktonic level, downstream benthic habitats utilized for foraging by adult sturgeon may  
30 experience a greater increase in productivity due to the potential increase in *Corbula* than if this  
31 upstream transfer occurs at higher trophic levels, such as planktivorous fish. BDCP habitat  
32 restoration would increase the availability of foraging and refuge habitats available to rearing  
33 juvenile sturgeon. For further discussion, see Impact AQUA-9.

### 34 ***CM6 Channel Margin Enhancement***

35 Expanded nearshore habitat with improved inputs of terrestrial organic matter and insects, as well  
36 as woody debris, riparian shade, and underwater cover will increase the quality and area of  
37 potential rearing habitat for sturgeon. Enhancements are also expected to improve migration  
38 conditions for sturgeon, by increasing the availability and quality of resting (refuge) habitat, as a  
39 result of increased channel margin complexity (e.g., woody material), particularly during high flows.  
40 Despite the potential benefits of channel margin habitat restoration on white sturgeon, the overall  
41 effect is expected to be minimal because of the relatively short period of their life history spent in

1 these areas and therefore, the effect is not considered adverse. For further discussion see Impact  
2 AQUA-9.

3 **CM7 Riparian Natural Community Restoration**

4 White and green sturgeon rely on ecological attributes of valley/foothill riparian habitat in the Plan  
5 Area.

6 BDCP habitat restoration, including riparian restoration, are expected to improve the quality and  
7 quantity of Delta rearing habitats for juvenile sturgeon. Once established, these habitats would likely  
8 provide suitable food resources for juvenile sturgeon. For further discussion, see Impact AQUA-9.

9 **CM10 Nontidal Marsh Restoration**

10 As discussed under delta smelt, upland restoration under *CM10 Nontidal Marsh Restoration* is  
11 expected to have minor indirect beneficial effects on white sturgeon in the main river systems and  
12 Delta. These upland wetlands provide hydrologic and water quality functions such as storing water  
13 during floods and filtering contaminants. These sites would also provide some additional food  
14 resources such as insects, zooplankton, phytoplankton and dissolved organic carbon. These  
15 materials would be exported during flood stages when the upland might be connected to the river  
16 system. Although the contribution from 400 acres would be small, it would be beneficial. For  
17 additional discussion, see Impact AQUA-9.

18 **NEPA Effects:** The effects on white sturgeon from floodplain, tidal, channel margin, and riparian  
19 habitat restoration activities are expected to be similar to those discussed for delta smelt (see  
20 Impact AQUA-9). In general, these effects are expected to be beneficial for white sturgeon, although  
21 the primary benefits are likely to be the result of increased productivity from more frequent  
22 inundations of restoration areas and the increased amount and quality of available rearing and  
23 migration habitat.

24 Despite the improvements in habitat and habitat functions in the Delta from floodplain, tidal,  
25 channel margin, and riparian habitat restoration activities, habitat quality is expected to decline in  
26 the LLT primarily because of climate change. However, the overall effect of restoration activities is  
27 expected to remain beneficial for white sturgeon.

28 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
29 management plan would be needed to determine an operational protocol that optimizes benefits  
30 both locally and in adjacent habitats.

31 **CEQA Conclusion:** As with delta smelt, the overall effects of floodplain, tidal, channel margin, and  
32 riparian habitat restoration activities are expected to be beneficial for white sturgeon (see Impact  
33 AQUA-9). The primary benefits are likely due to increased productivity from more frequent  
34 inundations of restoration areas and increased amount and quality of available rearing and  
35 migration habitat. Despite the improvements in habitat and habitat functions in the Delta from these  
36 habitat restoration activities, habitat quality is expected to decline in the LLT primarily because of  
37 climate change. However, the overall impact of restoration activities is expected to remain beneficial  
38 for white sturgeon because they increase habitat. Consequently, no mitigation would be required.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

3 Refer to Impact AQUA-10 under delta smelt for a discussion of the potential effects of  
4 methylmercury management on white sturgeon.

5 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**  
6 **(CM13)**

7 **NEPA Effects:** The following analysis is based on the more detailed analysis included in *BDCP Effects*  
8 *Analysis – Appendix F, Biological Stressors, Section F.1.1 Invasive Aquatic Vegetation, Section F.4*  
9 *Invasive Aquatic Vegetation, and F.5.3.2.3 Nonnative Aquatic Vegetation Control (Conservation*  
10 *Measure 13) hereby incorporated by reference.*

11 A general analysis of the effects on covered fish species has been conducted that was described  
12 above for delta smelt (see Impact AQUA-11). Potential impacts on white sturgeon from IAV control  
13 during operations are similar to those discussed for delta smelt. The impact of IAV removal on  
14 predation risk for sturgeon is expected to be low. Sturgeon grow rapidly and can quickly outgrow  
15 the size range where predation could occur. Sturgeon also have a protective amour like plating  
16 making them unappealing to predators even at a young age. Therefore, the effect of IAV removal on  
17 white sturgeon is expected to be slight.

18 The control of IAV with implementation of *CM13 Invasive Aquatic Vegetation Control* is expected to  
19 maintain or improve turbidity conditions that could benefit white sturgeon rearing conditions,  
20 reducing their susceptibility to predation. The control of IAV would also increase the amount of  
21 rearing habitat, as well as access to the habitat and potential increases in food availability.  
22 Therefore, IAV control is expected to provide an overall benefit to white sturgeon.

23 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to white sturgeon during  
24 operations through chemical and mechanical treatment. Control of IAV is considered a beneficial  
25 impact by reducing predation mortality, increasing food availability, and increasing rearing habitat.  
26 This impact is expected to be beneficial, consequently, no mitigation would be required.

27 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

28 **NEPA Effects:** As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very  
29 similar to Existing Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP  
30 export service areas (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14*  
31 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would increase the dissolved  
32 oxygen levels and improve the rearing and upstream migration conditions for white sturgeon, which  
33 would be a benefit.

34 **CEQA Conclusion:** As discussed in Chapter 8, *Water Quality*, *CM14 Stockton Deepwater Ship Channel*  
35 *Dissolved Oxygen Levels* management would increase the dissolved oxygen levels and improve the  
36 rearing and upstream migration conditions for white sturgeon, which would be a benefit.  
37 Consequently, no mitigation would be required.

1 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**  
2 **(CM15)**

3 To the extent that localized predator control efforts of *CM15 Localized Reduction of Predatory Fish*  
4 reduce the overall abundance of fish predators in the Delta occupied by white sturgeon, it is  
5 possible, but not assured that there would be some reduction in losses to predation, although no  
6 quantitative information is available regarding the current magnitude of white sturgeon loss to  
7 predation (see Impact AQUA-13). Due to these uncertainties, there would be no demonstrable effect  
8 of this conservation measure on white sturgeon.

9 Additionally, although little is known about predation of juvenile sturgeon in the Delta. Sturgeon  
10 grow rapidly in their first year of development and grow protective bony plating at an early age.  
11 Young sturgeon grow quickly in their first year, probably reaching 30 cm (12 inches) in their first  
12 year (Kohlhorst and Cech 2001b). Due to their rapid growth early in their development, the period  
13 in which juvenile sturgeon are vulnerable to piscivorous fish predators in the Delta is likely limited,  
14 and therefore the any potential beneficial effects from implementation of *CM15 Localized Reduction*  
15 *of Predatory Fish* are further limited. In addition, sturgeon are benthic feeders, which may limit their  
16 encounters with pelagic predators like striped bass.

17 As discussed for green sturgeon, a potential risk of localized predator removal is the by-catch of  
18 sturgeon during beach seining, gill netting, angling, electrofishing, or other capture methods.  
19 Sturgeon tend to reside in deep water areas and should be protected from electrofishing effects.  
20 Striped bass monitoring by CDFW at Knights Landing using fyke traps caught 86 white sturgeon but  
21 only four green sturgeon in 26 days of sampling in 2008 (Dubois and Mayfield 2008), they also  
22 report the capture of 14 white sturgeon and one green sturgeon during up to 24 days of gill net  
23 sampling. Adult sturgeon are not susceptible to being caught using artificial lures commonly used to  
24 catch striped bass but would be susceptible to baited hooks. Injuries to sturgeon would be similar to  
25 those experiences by salmonids listed above. Adult sturgeon in deep water should be able to avoid  
26 most types of nets fished in shallow nearshore areas. Adult sturgeon caught in nets (fyke, beach  
27 seine, or gill nets) could suffer similar injuries as salmonids such as ones listed above.

28 **NEPA Effects:** This effect would not be adverse because the number of sturgeon affected by this  
29 variety of methods is expected to be very low.

30 **CEQA Conclusion:** Due to the uncertainties concerning overall fish predator reduction and actual  
31 predation rates on white sturgeon in the Delta, there would be no demonstrable effect on this  
32 conservation measure on white sturgeon. Little is known about predation of juvenile sturgeon in the  
33 Delta. Sturgeon grow rapidly in their first year of development and grow protective bony plating at  
34 an early age. Due to rapid early growth, the period in which juvenile sturgeon are vulnerable to  
35 piscivorous fish predators in the Delta is likely limited, and therefore any potential beneficial  
36 impacts from implementation of *CM15 Localized Reduction of Predatory Fish* are further limited.

37 One potential risk of localized predator removal is by-catch of sturgeon during beach seining, gill  
38 netting, angling, electrofishing, or other capture methods. As indicated above, these methods have  
39 variable effectiveness at capturing sturgeon. Adult sturgeon aren't susceptible to being caught using  
40 artificial lures commonly used to catch striped bass but would be susceptible to baited hooks. Adult  
41 sturgeon in deep water should be able to avoid most types of nets fished in shallow nearshore areas.  
42 Therefore the impact is considered less than significant because it would not have a substantial  
43 effect on white sturgeon numbers. Consequently, no mitigation would be required.

1 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

2 **NEPA Effects:** Effects on sturgeon from predation associated with the construction of NPBs is  
3 unknown. White sturgeon are known to spawn in the Sacramento and Feather rivers in the Central  
4 Valley (Israel et al. 2010) and emigrating juveniles would likely encounter the Georgiana Slough  
5 barrier. White sturgeon rarely occur or spawn in the San Joaquin River (Moyle 2002; Beamesderfer  
6 et al. 2007), so the level of interaction of sturgeon juveniles with the Old River NPB is likely to be  
7 minimal. NPBs are likely to attract piscivorous predators hiding among the physical structures of the  
8 barrier and may create an increased predation risk for small sturgeon juveniles. Sturgeon may also  
9 be deterred by the sound and lights of the barrier (Popper 2005; Meyer et al. 2010; Halvorsen et al.  
10 2012) thereby minimizing their entry into areas of the central Delta where high predation rates  
11 would be likely. The effect would not be adverse, compared to NAA.

12 **CEQA Conclusion:** Effects on sturgeon from predation associated with the construction of NPBs is  
13 unknown. White sturgeon are known to spawn in the Sacramento and Feather rivers in the Central  
14 Valley (Israel et al. 2010) and emigrating juveniles would likely encounter the Georgiana Slough  
15 barrier. White sturgeon are not known to currently spawn in the San Joaquin River although they  
16 may have historically (Moyle 2002; Beamesderfer et al. 2007). Therefore, the level of interaction of  
17 sturgeon juveniles with the Old River NPB is likely to be minimal. NPBs are likely to attract  
18 piscivorous predators hiding among the physical structures of the barrier and may create an  
19 increased predation risk for small sturgeon juveniles. Sturgeon may also be deterred by the sound  
20 and lights of the barrier (Popper 2005; Meyer et al. 2010; Halvorsen et al. 2012) thereby minimizing  
21 their entry into areas of the central Delta where high predation rates would be likely. The overall  
22 impact on white sturgeon from NPBs is less than significant because it would not reduce their  
23 numbers. Consequently, no mitigation would be required.

24 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

25 **NEPA Effects:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley  
26 steelhead, green sturgeon and white sturgeon and are expected to have beneficial effects on their  
27 populations.

28 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
29 Valley steelhead, green sturgeon and white sturgeon. Although the numbers cannot be quantified  
30 implementation is expected to have positive effects on their populations. The impact would be  
31 beneficial because it would increase their numbers. Consequently, no mitigation would be required.

32 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

33 **NEPA Effects:** *CM18 Conservation Hatcheries* would establish new and expand existing conservation  
34 propagation programs for delta and longfin smelt. This conservation measure would have no effect  
35 on white sturgeon.

36 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing  
37 conservation propagation programs for delta and longfin smelt. This conservation measure would  
38 have no impact on white sturgeon. Consequently, no mitigation would be required.

39 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

40 **NEPA Effects:** The effects of Urban stormwater treatment (CM19) would reduce contaminants  
41 associated with urban areas because it provides for the treatment of stormwater discharges. As

1 discussed in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled  
2 *Pyrethroids, Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment  
3 would reduce urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and  
4 other contaminants. These reductions would contribute to improved water quality in the Delta.  
5 Based on the improved overall water quality conditions and reduced pesticides the effect would be  
6 beneficial.

7 **CEQA Conclusion:** Urban stormwater treatment (CM19) would reduce contaminants associated  
8 with urban areas because it would provide for the treatment of stormwater discharges. As discussed  
9 in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
10 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
11 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
12 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore,  
13 the impacts of urban stormwater treatment would be beneficial because it would have a beneficial  
14 effect both directly and through habitat modifications on white sturgeon. Consequently, no  
15 mitigation would be required.

#### 16 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White** 17 **Sturgeon (CM21)**

18 **NEPA Effects:** As discussed above for other species, there is no evidence of substantial entrainment  
19 of covered fish species at agricultural diversions in the Plan Area, but slight reductions in  
20 entrainment are expected from decommissioning agricultural diversions in the ROAs (see Impact  
21 AQUA-18). These effects would not be adverse, and a slight benefit may result.

22 **CEQA Conclusion:** Although there is no evidence of substantial entrainment of covered fish species  
23 at agricultural diversions in the Plan Area, slight reductions in entrainment are expected from  
24 decommissioning agricultural diversions in the ROAs (see Impact AQUA-18). This impact would be  
25 less than significant and may result in a slight benefit to white sturgeon because it would reduce  
26 entrainment which would have a positive impact on white sturgeon numbers. Consequently, no  
27 mitigation would be required.

#### 28 **Pacific Lamprey**

##### 29 **Construction and Maintenance of CM1**

#### 30 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

31 Pacific lamprey are present throughout the Delta. Table 11-4 illustrates the life stages of Pacific  
32 lamprey present in these areas during the expected in-water construction window (June 1–October  
33 31). Ammocoetes (larvae) are present year-round in all of the regions. Adult and macrophthimia life  
34 stages may also be migrating by the construction sites for intakes and barge landings from June to  
35 August in all Delta subregions

##### 36 **Temporary Increases in Turbidity**

37 Pacific lamprey ammocoetes may occur throughout the Delta during construction of the intake  
38 structures and barge landings, and adults and macrophthimia may also occur during portions of the  
39 in-water construction period. Pacific lamprey typically inhabit turbid water; therefore, they are  
40 unlikely to be affected by a temporary increase in turbidity. As discussed for delta smelt (see Impact

1 AQUA-1), environmental commitments would be implemented to minimize turbidity during  
2 construction activities (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental*  
3 *Commitments: Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
4 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
5 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
6 *and Salvage Plan; and Barge Operations Plan*). Pertinent details of these plans are provided under  
7 Impact AQUA-1 for delta smelt.

### 8 ***Accidental Spills***

9 Potential impacts on Pacific lamprey from accidental spills during construction are similar to those  
10 discussed for delta smelt (see Impact AQUA-1). Effects would be minimized by implementing the  
11 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
12 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
13 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
14 *Containment, and Countermeasure Plan)*. Specifically, the *Spill Prevention, Containment, and*  
15 *Countermeasure Plan* would be expected to minimize the potential for introduction of contaminants  
16 to surface waters and provide for effective containment and cleanup should accidental spills occur.  
17 Pertinent details of these plans are discussed under Impact AQUA-1 for delta smelt

### 18 ***Disturbance of Contaminated Sediments***

19 There is a potential risk of contaminated sediments affecting Pacific lamprey during construction of  
20 intake structures and barge landings. Because they are filter feeders and are partially buried in the  
21 substrate, the ammocoetes could be the most affected life stage by the disturbance of sediment  
22 contaminants. However, the suspension of sediments would be minimized by implementation of  
23 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
24 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
25 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
26 *Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged*  
27 *Material; Fish Rescue and Salvage Plan; and Barge Operations Plan)*. Pertinent details of these plans  
28 are provided under Impact AQUA-1 for delta smelt.

### 29 ***Underwater Noise***

30 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
31 Pacific lamprey. It is important to note that the impact would be realized only where piles must be  
32 impact driven; underwater sound generated by vibratory pile installation methods are not  
33 sufficiently loud to injure fish.

34 Potential impacts on Pacific lamprey from pile driving are different from other fish species. In a  
35 study done by Popper (2005) on hearing by sturgeon and lamprey, it was found that lamprey do not  
36 have the typical hearing structures of other fish. Although there have been no studies to determine  
37 responses of lamprey to sound (Popper 2005), ammocoetes are partially buried in the substrate,  
38 and the substrate dampens vibrations and noise. As a result, at least some life stages of Pacific  
39 lamprey could be somewhat less susceptible to injury from impact pile driving than other fish  
40 species.

41 Adult, ammocoete, and macrophthalmia life stages could be present in the vicinity of the intakes and  
42 barge landings during in-water pile driving activities. While adults would primarily occur between

1 June and July and macrophthalmia in June, ammocoetes would occur throughout the year. However,  
2 the abundance of ammocoetes is low at all in-water pile driving sites. Adults are considered  
3 moderately abundant in June and July near the intakes, but of low abundance in the east and south  
4 Delta where barge landings would be located. Macrophthalmia would be primarily migrating  
5 downstream, and during only a portion of the in-water construction period. Therefore their  
6 exposure to pile driving sound levels would likely be limited.

7 Given their likely low numbers in the east and south Delta, the relatively small areas affected by  
8 underwater noise in the east and south Delta, and the intermittent nature of potential exposure  
9 above the effects threshold, there is only a small chance that lamprey would be exposed to injurious  
10 underwater sounds from impact pile driving at the barge landings. However, adults would be  
11 moderately abundant in June and July near the intakes, resulting in the potential for adverse effects  
12 as a result of underwater pile driving sound levels. Implementation of Mitigation Measures AQUA-1a  
13 and AQUA-1b would reduce the severity of these effects. Overall, underwater construction noise  
14 would be expected to adversely affect individual lamprey, although these effects are not expected to  
15 affect the overall population.

### 16 ***Fish Stranding***

17 In-water work activities have the potential to injure or kill fish through the process of rescuing fish  
18 from construction areas. Pacific lamprey adults pass by the proposed intake facilities during the  
19 spawning migration from saltwater to freshwater spawning areas. The adults pass upstream of the  
20 proposed facilities during spring and early summer, and may be present from March through  
21 August. Ammocoetes could be present in the vicinity of the intake facilities, depending on the  
22 presence of mud or sand substrate. Outmigrating juveniles (macrothalmia life stage) also pass  
23 through the area, typically during high-flow events in winter and spring (January through June) and  
24 could be in the vicinity of construction during the early portion of the expected (June through  
25 October) in-water work window (see Table 11-4).

26 Pacific lamprey may be present during cofferdam installation, and could be trapped within the  
27 cofferdams, and would therefore need to be removed. Fish removal activities from construction  
28 areas would be implemented according to environmental commitment *Fish Rescue and Salvage Plan*,  
29 as described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*.  
30 Pertinent details of this plan are discussed under Impact AQUA-1 for delta smelt. Because of these  
31 measures, the risk of substantial effects would be minimized.

### 32 ***In-Water Work Activities***

33 As discussed for delta smelt (see Impact AQUA-1), in-water work activities have the potential to  
34 disturb, injure or kill fish through direct physical injury from construction activities. Although some  
35 fish might avoid the noise and activity of pile installation and placement of riprap protection, these  
36 activities have the potential to injure or kill fish. Pacific lamprey ammocoetes are buried in the  
37 substrate and are likely to stay under the substrate unless directly disturbed. Installation of sheet  
38 piles, support piles, and riprap has the potential to injure or kill those lamprey ammocoetes that  
39 have not been displaced by other construction activities. Due to the low number of Pacific lamprey  
40 or their ammocoetes expected in these locations, and implementation of environmental  
41 commitment *Fish Rescue and Salvage Plan*, as described under Impact AQUA-1 and in Appendix 3B,  
42 *Environmental Commitments*, the risk of substantial effects would be minimized.

1 **Loss of Spawning, Rearing, or Migration Habitat**

2 The habitat affected by construction activities is used by Pacific lamprey for migration and possibly  
3 rearing, depending on the specific site conditions. No spawning habitat is present for Pacific lamprey  
4 in the project areas. Because only about 10% of the river cross section would be blocked by the  
5 cofferdams, fish passage would be relatively unaffected, and there would be no substantial loss of  
6 Pacific lamprey migration habitat. If rearing habitat is present because of specific site conditions  
7 that habitat would be lost because of construction of permanent structures. However, other rearing  
8 habitat of similar quantity and quality is available for ammocoetes in the Sacramento River.

9 The construction of the intakes and barge landings will temporarily affect Pacific lamprey migration  
10 and rearing habitat, if present, and the intakes will permanently alter the nearshore portion of this  
11 habitat in the Sacramento River to the extent such habitat is present at the location of intakes.  
12 Because of implementation of *CM6 Channel Margin Enhancement*, the overall effects would be  
13 limited because of the relatively poor quality of the current habitat, and the enhancement or  
14 addition of new, higher quality habitat associated with *CM6 Channel Margin Enhancement*.  
15 Furthermore, environmental commitments described under Impact AQUA-1 and in Appendix 3B,  
16 *Environmental Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of Spoils, Reusable*  
17 *Tunnel Material, and Dredged Material*; and *Barge Operations Plan*, would minimize potential effects.  
18 Pertinent measures included in these plans are discussed under Impact AQUA-1 for delta smelt.

19 **Predation**

20 Adult lamprey are generally not preyed on by other fish in the Delta. Juvenile Pacific lamprey  
21 (macrothemia life stage) pass rapidly through the Delta, limiting the opportunity for larger fish to  
22 prey on them while they are in freshwater. Consequently, the addition of structures in the river and  
23 sloughs that could provide habitat for predatory fishes would likely result in a negligible effect on  
24 Pacific lamprey.

25 **Summary**

26 Ammocoetes (larvae) are present year-round in all of the regions, and adult spawner and  
27 macrothemia life stages may be migrating by the construction sites during portions of the in-water  
28 construction window in all Delta subregions. However, implementation of environmental  
29 commitments *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment*  
30 *Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and*  
31 *Countermeasure Plan*; and *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material* (see  
32 Impact AQUA-1 and Appendix 3B, *Environmental Commitments*) would reduce the amount of  
33 turbidity from in-water construction and would guide rapid and effective response in the case of  
34 inadvertent spills of hazardous materials. Pertinent details of these plans are provided under Impact  
35 AQUA-1 for delta smelt. These measures —as well as the species' tolerance to turbidity—would  
36 minimize the effects of construction activities on turbidity, accidental spills, onsite and offsite  
37 sediment transport to surface waters, and re-suspension and redistribution of potentially  
38 contaminated sediments. As a result, these effects would not be adverse to Pacific lamprey.

39 Some lamprey are expected to be present in the vicinity of the intakes and barge landings during  
40 pile driving activities. While the abundance of ammocoetes is expected to be low at all in-water pile  
41 driving sites, adults are likely to be moderately abundant in June and July near the intakes and in  
42 low abundance in the east and south Delta where barge landings would be located. Given their likely  
43 low numbers in the east and south Delta, the relatively small areas affected by underwater noise in

1 the east and south Delta, and the intermittent nature of potential exposure above the threshold,  
2 there is only a small chance that Pacific lamprey would be exposed to injurious underwater sounds  
3 from impact pile driving at the barge landings. However, adults would be moderately abundant in  
4 June and July near the intakes, resulting in a potential for adverse effects as a result of underwater  
5 sound. Implementation of Mitigation Measures Mitigation Measures AQUA-1a and AQUA 1b would  
6 reduce the severity of these effects. Overall, while pile driving could adversely affect individual  
7 lamprey, the effects on the overall population is not expected to be adverse.

8 Ammocoetes could be present in the vicinity of the intake facilities, depending on substrate  
9 conditions, and their removal may require handling, which could result in injury or mortality.  
10 Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge Operations*  
11 *Plan* (as described under Impact AQUA-1 and in Appendix 3B) would offset potential effects of  
12 construction activities on Pacific lamprey. As a result, these construction activities would not likely  
13 result in adverse effects on Pacific lamprey populations.

14 Adult lamprey are generally not preyed on by other fish in the Delta. Juvenile Pacific lamprey  
15 (macrothemia life stage) pass rapidly through the Delta, limiting the opportunity for larger fish to  
16 prey on them while they are in freshwater. Consequently, the addition of structures in the river and  
17 sloughs that could provide habitat for predatory fishes would result in a negligible effect on Pacific  
18 lamprey.

19 The habitat affected by construction activities is used by Pacific lamprey for migration and possibly  
20 rearing, depending on the specific site conditions. No spawning habitat is present for Pacific lamprey  
21 in the project areas. Because fish passage would be unaffected, there would be no substantial loss of  
22 Pacific lamprey migration habitat. Rearing habitat would be lost because of construction of  
23 permanent structures. However, other rearing habitat of similar quantity and quality is available for  
24 ammocoetes in the Sacramento River.

25 **NEPA Effects:** Overall, the potential effects of construction activities could adversely affect  
26 individual Pacific lamprey, but would not be expected to adversely affect the populations.

27 **CEQA Conclusion:** As discussed above, implementation of environmental commitments  
28 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
29 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and*  
30 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material* (see Impact AQUA-1 for delta  
31 smelt and Appendix 3B, *Environmental Commitments*) would reduce the amount of turbidity from in-  
32 water construction and would guide rapid and effective response in the case of inadvertent spills of  
33 hazardous materials. These measures—as well as the species' tolerance to turbidity—would  
34 minimize the effects of construction activities on turbidity, accidental spills, onsite and offsite  
35 sediment transport to surface waters, and re-suspension and redistribution of potentially  
36 contaminated sediments.

37 Pacific lamprey are expected to occur in the construction areas, and would be subject to the direct  
38 effects of underwater construction noise, which could be a significant impact because of the high  
39 likelihood that it could cause injury or death to fish in the immediate vicinity of the activity.  
40 However, Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for effects from  
41 underwater noise and would reduce the severity of impacts to a less-than-significant level.  
42 Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge Operations*  
43 *Plan* (as described under Impact AQUA-1 and in Appendix 3B) would also minimize potential  
44 impacts of construction activities on Pacific lamprey.

1 The limited susceptibility of lamprey to predation and only locally increased predator habitat and  
2 predation from the temporary construction structures (cofferdams and barge landing docks) would  
3 not have population level effects. The effect of temporary and permanent rearing and migration  
4 habitat loss for Pacific lamprey would be limited due to the relatively small areas occupied by the  
5 construction and barge landing sites, and the low quality of the habitat affected by construction, as  
6 well as by implementation of the Environmental Commitment *Barge Operations Plan* (see Appendix  
7 3B). Implementation of *CM6 Channel Margin Enhancement* would also result in a net improvement in  
8 channel margin habitat function. Based on the above the overall potential impacts of construction  
9 activities are expected to be less than significant, and no additional mitigation would be required.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

13 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
14 **and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

16 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

17 ***Temporary Increases in Turbidity***

18 As discussed for construction-related effects on turbidity (Impact AQUA-1), the potential increases  
19 in turbidity would be minimized to the extent possible through implementing the environmental  
20 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
21 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
22 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
23 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
24 *and Salvage Plan; and Barge Operations Plan)*. In addition, maintenance dredging would be  
25 conducted when the least numbers of Pacific lamprey are likely to be present. Pertinent details of  
26 these plans are provided under Impact AQUA-1 for delta smelt.

27 ***Accidental Spills***

28 Maintenance activities such as dredging, levee repair and placement of riprap could accidentally  
29 introduce contaminants into the aquatic environment. However, implementing the environmental  
30 commitments discussed under Impact AQUA-1 (Appendix 3B, *Environmental Commitments:*  
31 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
32 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan)*, as  
33 well as the limited frequency and duration of in-water maintenance, would reduce the likelihood of  
34 any significant contaminant input to the Sacramento River and potential effects on Pacific lamprey  
35 survival. Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

36 ***Underwater Noise***

37 As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
38 maintenance activities are not expected to reach a level that would harm juvenile or adult lamprey.  
39 NMFS has found that underwater sound pressure levels less than the 150 dB RMS behavioral effects  
40 threshold may result in temporary altered behavior of fishes indicative of stress but would not

1 result in permanent harm or injury (National Marine Fisheries Service 2001). Any increases in  
2 underwater noise would be temporary and infrequent, and would occur when the least number of  
3 Pacific lamprey are likely to be present.

#### 4 ***Maintenance-Related Disturbance***

5 Direct injury and mortality of Pacific lamprey from the use of in-water equipment during  
6 maintenance are most likely to occur during dredging activities around the new intakes. Suction  
7 dredging and mechanical excavation can capture or crush fish, causing injury or mortality. Pacific  
8 lamprey ammocoetes are present year-round in the Sacramento River. The ammocoetes may use  
9 both main channel areas and nearshore areas for rearing and migration. Because Pacific lamprey  
10 ammocoetes are buried in sediment, they may become entrained in the dredge. Maintenance  
11 dredging would take place when Pacific lamprey ammocoetes are in the area (they are present year-  
12 round). The number of Pacific lamprey ammocoetes that could be affected by dredging is unknown.  
13 However, because maintenance dredging would occur infrequently, for a short duration, and in  
14 limited areas, in-water maintenance activities would not affect Pacific lamprey populations.  
15 Furthermore, effects would be minimized by implementation of environmental commitments  
16 including *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
17 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
18 *Countermeasure Plan; and Barge Operations Plan*, described under Impact AQUA-1 for delta smelt  
19 and in Appendix 3B, *Environmental Commitments*.

#### 20 ***Loss of Spawning, Rearing, or Migration Habitat***

21 Pacific lamprey habitat near the intake structures is available for rearing and migration. Dredging  
22 would remove rearing habitat, especially if ammocoetes were present in the dredging footprint.  
23 Placing riprap on the bank would likely have limited effects on available rearing habitat. Migration  
24 habitat would not likely be affected by dredging or riprap placement, and additional migration  
25 habitat is available farther out in the channel. Maintenance activities would have limited effects on  
26 overall rearing habitat, because available rearing habitat of similar quality is readily accessible to  
27 Pacific lamprey. Furthermore, effects would be minimized by implementation of environmental  
28 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
29 *Commitments*.

#### 30 ***Predation***

31 Adult lamprey are generally not preyed on by other fish in the Delta. Juvenile Pacific lamprey  
32 (macrothemia life stage) pass rapidly through the Delta, limiting the opportunity for larger fish to  
33 prey on them while they are in freshwater. Maintenance activities would be unlikely to have any  
34 measurable effect on Pacific lamprey predation rates. These activities may include the use of barges  
35 and other watercraft that could theoretically provide cover, shelter, and perching areas for delta  
36 smelt predators. However, the limited duration of maintenance activities and the associated noise  
37 and disturbance would be expected to dissuade predators from concentrating at sufficient density to  
38 measurably affect predation rates on Pacific lamprey.

#### 39 ***Summary***

40 Pacific lamprey are tolerant to increases in turbidity, which might occur during maintenance  
41 activities. Such activities would include maintenance dredging at the intake sites, and installation or  
42 repair of riprap bank armoring. Implementation of the environmental commitments described

1 under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*  
2 (*Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
3 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and*  
4 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*), would further minimize or  
5 eliminate effects of turbidity, and accidental spills to Pacific lamprey. Pertinent details of these plans  
6 are provided under Impact AQUA-1 for delta smelt. In addition, underwater noise levels generated  
7 by maintenance activities are unlikely to affect lamprey.

8 While maintenance dredging would remove rearing habitat, especially if ammocoetes use habitat in  
9 the dredging footprint, placing riprap on the bank would likely have limited effects on available  
10 rearing habitat, because similar quality habitat is readily accessible to Pacific lamprey. Migration  
11 habitat would not be substantially affected by dredging or riprap placement, and additional  
12 migration habitat is available farther out in the channel. In addition, no spawning habitat occurs in  
13 the areas potentially affected by maintenance activities, and ample rearing, and migration habitat of  
14 the same quality is readily accessible in the area, and this habitat would not be affected by  
15 maintenance activities.

16 **NEPA Effects:** As a result, the effects of short-term maintenance activities would not likely be  
17 adverse to Pacific lamprey.

18 **CEQA Conclusion:** As described above, Pacific lamprey are tolerant to increases in turbidity, and  
19 implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
20 and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
21 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
22 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
23 *and Dredged Material*), would minimize or eliminate effects of turbidity, as well as potential effects  
24 from accidental spills to Pacific lamprey. In addition, underwater noise levels generated by  
25 maintenance activities are unlikely to affect lamprey.

26 While maintenance dredging would remove rearing habitat, especially if ammocoetes use habitat in  
27 the dredging footprint, effects would be limited because similar quality habitat is readily accessible  
28 to Pacific lamprey. Migration habitat would not be substantially affected by maintenance activities,  
29 and no spawning habitat occurs in these areas. In addition, ample rearing and migration habitat of  
30 the same quality is readily accessible in areas that would not be affected by maintenance activities.  
31 As a result, the impacts of short-term maintenance activities would be less than significant because  
32 it would not reduce Pacific lamprey habitat, restrict its range, or interfere with its movement.  
33 Consequently, no mitigation would be required.

## 34 **Water Operations of CM1**

### 35 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

#### 36 ***Water Exports from SWP/CVP South Delta Facilities***

37 Alternative 1A is expected to result in decreased entrainment of Pacific and river lamprey  
38 macrothemia and adults at the south Delta export facility compared to NAA. The estimated level of  
39 reduction (approximately 50%) is based solely on an assumption that proportional changes in flow  
40 lead to similar proportional changes in entrainment.

1 The analysis for Pacific and river lamprey was combined because the CVP and SWP fish salvage  
2 facilities do not distinguish between the two species. Salvage density estimates indicate that  
3 lamprey are most vulnerable to south Delta entrainment in January through May, particularly during  
4 January and February. CVP salvage is generally much higher than SWP salvage, particularly during  
5 peak salvage months. The large majority (approximately 85%) of salvaged lamprey are less than  
6 200 mm fork length (California Department of Fish and Wildlife 2013c), indicating that they are  
7 macrothemia, with the rest adults.

8 Estimated mean expanded salvage densities of lamprey for each month as reported by the facilities  
9 during water years 1996–2009 used in this analysis reflect historical expanded salvage density data.  
10 CVP lamprey salvage levels are estimated to be greater than SWP salvage levels. Salvage is estimated  
11 to occur primarily during January and February at the CVP, and during December to February with a  
12 minor second peak in May at the SWP.

13 Estimated average expanded salvage under baseline scenarios (all time periods) ranged from zero in  
14 September at the SWP to more than 1,300 at the CVP in January, for average annual totals of  
15 approximately 720–740 lamprey at the SWP and 2,600 lamprey at the CVP. The total annual  
16 estimated expanded salvage under Alternative 1A was approximately 50% less (1,700–1,800  
17 lamprey), and this was quite consistent across all time periods.

18 As with white and green sturgeon, reductions in south Delta export pumping are expected to  
19 decrease entrainment of Pacific and river lamprey macrothemia and adults under Alternative 1A  
20 relative to NAA. The estimated level of reduction (approximately 50%) is based solely on the  
21 assumption that proportional changes in flow lead to similar proportional changes in entrainment.

#### 22 ***Water Exports from SWP/CVP North Delta Intake Facilities***

23 Potential entrainment at the north Delta intakes occurs only under the action alternatives, including  
24 Alternative 1A, because there are no north Delta intakes operational under NAA. The north Delta  
25 intakes would be screened to exclude juvenile fish less than about 15 mm long (as evaluated in *BDCP*  
26 *Effects Analysis – Appendix 5B, Entrainment, Section B.5.9.2.1 Screening Effectiveness Analysis, hereby*  
27 *incorporated by reference*). Thus, the screens are expected to be protective of nearly all life stages of  
28 all covered fish species. While the screens would have varying effectiveness, based on species  
29 characteristic and diversion rates, the overall effectiveness is expected to be greater than for the  
30 existing screens at the south Delta facilities. However, the north Delta facilities would be located  
31 along the primary migration route for lamprey, which would likely offset the benefits achieved by  
32 the improved screen designs. Therefore, the overall effect could be a net increase in overall  
33 entrainment and impingement rates on lamprey and other covered fish species. The considerable  
34 along-bank length of each of the intakes necessitates monitoring (which is included in the adaptive  
35 management component of the project) to confirm that fish are indeed being excluded from  
36 entrainment and impingement in the manner that the design specifications suggest.

#### 37 ***Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct***

38 Entrainment of Pacific lamprey at the North Bay Aqueduct has not been explicitly analyzed.  
39 However, the Barker Slough Pumping Plant is screened for fish >25mm although lamprey would be  
40 longer than this because of their body shape. The alternative intake would presumably have screens  
41 of 1.75-m mesh and therefore it would exclude lamprey >50-60 mm based on north Delta intake  
42 analysis (as evaluated in *BDCP Effects Analysis – Appendix 5B, Entrainment, Section B.5.9.2.1*

1 *Screening Effectiveness Analysis, hereby incorporated by reference*). Overall effects would be expected  
2 to be no greater than for delta smelt.

3 If unforeseen changes in distributions or other factors occur as a result of project operations that  
4 would increase proportional loss of Pacific lamprey to entrainment, monitoring and the BDCP-  
5 proposed Real-Time Response Team would implement measures to avoid or minimize any potential  
6 threats to the species that might occur. Based on the current analysis, this would not be necessary.

#### 7 ***Predation Associated with Entrainment***

8 Predation can occur in association with the various intakes. No studies have been performed to  
9 assess the vulnerability of lamprey to predation within CCF as a consequence of fish salvage  
10 operations. Based on their size it has been assumed for purposes of this document that lamprey  
11 would be vulnerable to predation in a manner similar to that observed for juvenile salmon, striped  
12 bass, and steelhead (Gingras 1997; Clark et al. 2009). Therefore, the risk of predation mortality  
13 within CCF is assumed to be approximately 80%, and the risk of predation associated with the CVP  
14 trash racks is assumed to be 15%. Reduced exports from the south Delta would reduce the total  
15 number of lamprey entrained at the export facilities, but the proportion of entrained lamprey lost to  
16 predation is expected to remain the same under CM1. Lamprey are expected to experience increased  
17 predation in the Sacramento River due to the construction of the north Delta export facilities,  
18 although the certainty is very low.

19 ***NEPA Effects:*** Based on the projected entrainment (salvage rates) of Pacific lamprey under the  
20 BDCP, a substantial reduction is expected at the south Delta export facilities. However, the potential  
21 entrainment of juvenile lamprey at the north Delta intake facilities raises some uncertainty  
22 concerning the overall change in entrainment rate. This uncertainty will be addressed through  
23 monitoring and adaptive management actions. The project adaptive management plan includes  
24 monitoring of the new north Delta screens to determine their effectiveness and if they are not  
25 meeting expectations additional measures (i.e., modifications to screens or other structural  
26 components or changes in water diversion operations) may be implemented to improve screen  
27 performance. Based on available information, overall entrainment effects on Pacific lamprey  
28 populations are not expected to be substantially reduced under Alternative 1A, therefore it is  
29 anticipated that there will not be an adverse effect on Pacific lamprey and there may be beneficial  
30 effects due to design, installation and operation of new screens in the north Delta.

31 ***CEQA Conclusion:*** As described above, operational activities associated with water exports from  
32 south SWP/CVP facilities are expected to substantially reduce entrainment of lamprey. However,  
33 operational activities associated with water exports from SWP/CVP north Delta intake facilities  
34 could result in an increase in entrainment or a loss of individual lamprey at that location. Monitoring  
35 and adaptive management protocols will be implemented to confirm that fish, including lamprey,  
36 are being excluded from entrainment and impingement in the manner that the design specifications  
37 suggest. Overall, the impacts of Alternative 1A water operations to Pacific lamprey are considered  
38 less than significant because they would not substantially reduce their numbers. Consequently, no  
39 mitigation would be required.

#### 40 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 41 **Pacific Lamprey**

42 In general, effects of Alternative 1A would reduce the quantity and quality of Pacific lamprey  
43 spawning habitat relative to NAA.

1 Flow-related impacts on Pacific lamprey spawning habitat were evaluated by estimating effects of  
2 flow alterations on egg exposure, called redd dewatering risk, and effects on water temperature. A  
3 redd is a gravel-covered nest of eggs; Pacific lamprey eggs take between 18 and 49 days to incubate  
4 and must remain covered by sufficient water for that time. Rapid reductions in flow can dewater  
5 redds leading to mortality. Locations for each river used in the dewatering risk analysis were based  
6 on available literature, personal conversations with agency experts, and spatial limitations of the  
7 CALSIM II model, and include the Sacramento River at Keswick, Sacramento River at Red Bluff,  
8 Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, and American River at  
9 Nimbus Dam and at the confluence with the Sacramento River. Pacific lamprey spawn in these rivers  
10 between January and August so flow reductions during those months have the potential to dewater  
11 redds, which could result in incomplete development of the eggs to ammocoetes (the larval stage).  
12 Water temperature results from the SRWQM and the Reclamation Temperature Model were used to  
13 assess the exceedances of water temperatures under all model scenarios in the upper Sacramento,  
14 Trinity, Feather, American, and Stanislaus rivers.

15 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-  
16 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning  
17 location suitability characteristics (e.g., depth, velocity, substrate) of Pacific lamprey are not  
18 adequately described to employ a more formal analysis such as a weighted usable area analysis.  
19 Therefore, the change in month-over-month flows is used as a surrogate for a more formal analysis,  
20 and a month-over-month flow reduction of 50% was chosen as a best professional estimate of flow  
21 conditions in which redd dewatering is expected to occur, but does not estimate empirically derived  
22 redd dewatering events. As such, there is uncertainty that these values represent actual redd  
23 dewatering events, and results should be treated as rough estimates of flow fluctuations under each  
24 model scenario. Results were expressed as the number of cohorts exposed to dewatering risk and as  
25 a percentage of the total number of cohorts anticipated in the river based on the applicable time-  
26 frame, January to August.

27 These results indicate no effect or a beneficial effect of Alternative 1A on the number of Pacific  
28 lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than  
29 50% in the Sacramento, Trinity, and American Rivers. Alternative 1A would result in an increase  
30 (42%) in the number of cohorts predicted to experience a month-over-month change of flow greater  
31 than 50% in the Feather River (Table 11-1A-71). Because this is isolated to a single location in the  
32 Feather River, it is not expected to cause a population level effect on Pacific lamprey.

1 **Table 11-1A-71. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**  
2 **Cohorts<sup>a</sup>**

Location	Comparison <sup>b</sup>	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River at Keswick	Difference	7	-15
	Percent Difference	13%	-19%
Sacramento River at Red Bluff	Difference	-3	-21
	Percent Difference	-6%	-29%
Trinity River down-stream of Lewiston	Difference	-2	-2
	Percent Difference	-2%	-2%
Feather River at Thermalito Afterbay	Difference	3	45
	Percent Difference	2%	42%
American River at Nimbus Dam	Difference	27	-10
	Percent Difference	32%	-8%
American River at Sacramento River confluence	Difference	35	-5
	Percent Difference	37%	-4%

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

<sup>b</sup> Positive values indicate a higher value in Alternative 1A than in the baseline.

3  
4 Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C  
5 (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the  
6 number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least  
7 one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis  
8 predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C  
9 (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual  
10 day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River,  
11 corresponding to 82 years of eggs being laid every day each year from January 1 through August 31,  
12 and 648 cohorts for the other rivers using monthly data over the same period. The incubation  
13 periods used in this analysis are conservative and represent the extreme long end of the egg  
14 incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited  
15 because the extreme temperatures are masked; however, no better analytical tools are currently  
16 available for this analysis. Exact spawning locations of Pacific lamprey are not well defined.  
17 Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

18 In most locations, egg cohort exposure would not differ between NAA and Alternative 1A (Table 11-  
19 1A-72). However, the number of cohorts exposed to 22°C (71.6°F) under Alternative 1A would be  
20 5% lower in the Sacramento River at Hamilton City and 91% higher in the Feather River at  
21 Thermalito Afterbay. Because this is isolated to a single location in the Feather River, it is not  
22 expected to cause a population level effect on Pacific lamprey.

1 **Table 11-1A-72. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg**  
 2 **Cohort Temperature Exposure<sup>a</sup>**

Location	EXISTING CONDITIONS	
	vs. A1A_LL1	NAA vs. A1A_LL1
Sacramento River at Keswick	0 (NA)	1 (2%)
Sacramento River at Hamilton City	369 (NA)	-56 (-5%)
Trinity River at Lewiston	2 (NA)	2 (40%)
Trinity River at North Fork	-2 (NA)	-5 (-28%)
Feather River at Fish Barrier Dam	0 (NA)	-1 (-100%)
Feather River below Thermalito Afterbay	89 (371%)	84 (91%)
American River at Nimbus	33 (300%)	2 (2%)
American River at Sacramento River Confluence	87 (155%)	-3 (-1%)
Stanislaus River at Knights Ferry	0 (NA)	0 (0%)
Stanislaus River at Riverbank	22 (1,100%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F during January to August on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

3  
 4 **NEPA Effects:** These results indicate that the effect would be adverse because it has the potential to  
 5 substantially reduce suitable spawning habitat and substantially reduce the number of fish as a  
 6 result of egg mortality. There would be increases in egg cohorts (exposed to redd dewatering risk  
 7 (45 cohorts or 45%) and temperatures greater than 71.6°F (84 cohorts or 91%) in the Feather River  
 8 below Thermalito Afterbay. Increased redd dewatering risk and exposure risk to egg cohorts below  
 9 Thermalito Afterbay would reduce spawning success. These effects would cause substantial  
 10 reductions in habitat available for spawning and egg incubation in the Feather River. While the  
 11 implementation of the mitigation measures listed below (Mitigation Measures AQUA-166a through  
 12 AQUA-166c) would reduce the severity of effects, this would not necessarily result in a not adverse  
 13 determination.

14 **CEQA Conclusion:** In general, Alternative 1A would reduce the quantity and quality of Pacific  
 15 lamprey spawning habitat relative to the Existing Conditions.

16 Rapid reductions in flow can dewater redds leading to mortality. Predicted effects of Alternative 1A  
 17 in the Sacramento River and American River are for increases in the number of redd cohorts  
 18 predicted to experience a month-over-month change in flow of greater than 50% relative to Existing  
 19 Conditions (Table 11-1A-71). Changes would be most substantial for the American River (increased  
 20 risk of dewatering exposure to 35 cohorts or 37% at Nimbus Dam, and 40 cohorts or 42% at the  
 21 confluence). There would be 13% higher dewatering risk in the Sacramento River at Keswick, but a  
 22 6% reduction at Red Bluff. In the Feather River, there are 3 more redd cohorts (2%) predicted to  
 23 experience a month-over-month change in flow of greater than 50% for Alternative 1A relative to  
 24 Existing Conditions. No effects are predicted for the Feather or Trinity Rivers (<5%). Therefore,  
 25 Alternative 1A would not have biologically meaningful effects on Pacific lamprey redd dewatering  
 26 risk in the Feather River, Trinity River, and Sacramento River at Red Bluff; but would affect  
 27 dewatering risk in the Sacramento River at Keswick and the American River).

1 The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 1A would be greater than  
2 that under Existing Conditions in all rivers except the Trinity River (Table 11-1A-72).

3 Collectively, the results indicate that the impact would be significant because the alternative could  
4 substantially reduce suitable spawning habitat and substantially reduce the number of fish as a  
5 result of egg mortality, contrary to the NEPA conclusion set forth above. There would be increases in  
6 egg cohorts exposed to redd dewatering risk in the Sacramento and American Rivers (7 to 35 more  
7 cohorts, or 13% to 37%). There would also be increases in egg cohorts exposed to water  
8 temperatures above 71.6°F in at least one location in all rivers except the Trinity River (22 to 269  
9 more cohorts, or up to 1100%). Increased exposure to redd dewatering and elevated water  
10 temperatures would reduce egg survival. While the implementation of the mitigation measures  
11 listed below (Mitigation Measures AQUA-166a through AQUA-166c) would reduce the severity of  
12 effects, this would not necessarily result in a less than significant determination.

13 **Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional**  
14 **Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of**  
15 **Mitigation to Reduce Impacts to Spawning Habitat**

16 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
17 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
18 the best available scientific information at the time and may prove to have been over- or  
19 understated. Upon the commencement of operations of CM1 and continuing through the life of  
20 the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine  
21 whether such effects would be as extensive as concluded at the time of preparation of this  
22 document and to determine any potentially feasible means of reducing the severity of such  
23 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
24 consistent with the operational framework for Alternative 1A.

25 The development and implementation of any mitigation actions shall be focused on those  
26 incremental effects attributable to implementation of Alternative 1A operations only.  
27 Development of mitigation actions for the incremental impact on spawning habitat attributable  
28 to climate change/sea level rise are not required because these changed conditions would occur  
29 with or without implementation of Alternative 1A.

30 **Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts**  
31 **on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1**

32 Following commencement of initial operations of CM1 and continuing through the life of the  
33 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
34 modified operations could reduce impacts to spawning habitat under Alternative 1A. The  
35 analysis required under this measure may be conducted as a part of the Adaptive Management  
36 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

37 **Mitigation Measure AQUA-166c: Consult with USFWS and CDFW to Identify and**  
38 **Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning**  
39 **Habitat Consistent with CM1**

40 In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey  
41 habitat, the BDCP proponents will consult with USFWS and the Department of Fish and Wildlife  
42 to identify and implement any feasible operational means to minimize effects on spawning

1 habitat. Any such action will be developed in conjunction with the ongoing monitoring and  
2 evaluation of habitat conditions required by Mitigation Measure AQUA-166a.

3 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
4 operational framework of Alternative 1A without causing new significant adverse impacts on  
5 other covered species, such means shall be implemented. If sufficient operational flexibility to  
6 reduce effects on Pacific lamprey habitat is not feasible under Alternative 1A operations,  
7 achieving further impact reduction pursuant to this mitigation measure would not be feasible  
8 under this alternative, and the impact on river lamprey would remain significant and  
9 unavoidable.

### 10 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

11 In general, Alternative 1A would have negligible effects on Pacific lamprey rearing habitat  
12 conditions relative to NAA due to negligible effects on critical water temperatures and flow  
13 reductions that would increase stranding risk. Flow-related impacts to Pacific lamprey rearing  
14 habitat were evaluated by estimating effects of flow alterations on ammocoete exposure, called  
15 ammocoete stranding risk. Lower flows can reduce the instream area available for rearing and rapid  
16 reductions in flow can strand ammocoetes leading to mortality. Comparisons of effects were made  
17 for ammocoete cohorts in the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather  
18 River, and the American River at Nimbus Dam and at the confluence with the Sacramento River. An  
19 ammocoete is the filter-feeding larval stage of the lamprey that remains relatively immobile in the  
20 sediment in the same location for 5 to 7 years, after which it migrates downstream. During the  
21 upstream rearing period there is potential for ammocoete stranding from rapid reductions in flow.

22 The analysis of ammocoete stranding was conducted by analyzing a range of month-over-month  
23 flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of  
24 ammocoetes was assumed to be born every month during their spawning period (January through  
25 August) and spend 7 years rearing upstream. Therefore, a cohort was considered stranded if at least  
26 one month-over-month flow reduction was greater than the flow reduction at any time during the  
27 period.

28 Effects of Alternative 1A on Pacific lamprey ammocoete stranding were analyzed by calculating  
29 month-over-month flow reductions for the Sacramento River at Keswick for January through August  
30 (Table 11-1A-73). There would generally be no effects of A1A\_LL1 on stranding risk, except at the  
31 65% reduction value (7% increase).

32 Results of comparisons for the Sacramento River at Red Bluff provide similar conclusions (Table 11-  
33 1A-74). There would generally be no effect or a decrease in the risk of ammocoete stranding under  
34 A1A\_LL1 relative to NAA, except in the 60% flow reduction (5% increase in exposure risk).

1 **Table 11-1A-73. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**  
 3 **Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	7
-70%	4	0
-75%	1	0
-80%	9	1
-85%	4	0
-90%	NA	NA

NA = all values were 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

4

5 **Table 11-1A-74. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 7 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	4	0
-60%	7	5
-65%	-2	-3
-70%	9	-2
-75%	0	-9
-80%	5	-7
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

8

9 Comparisons for the Trinity River indicate no effect (0%) or negligible changes (4%) attributable to  
 10 A1A\_LLT (Table 11-1A-75).

1 **Table 11-1A-75. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	21	-3
-80%	28	0
-85%	18	0
-90%	41	4

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

3  
4 In the Feather River, all comparisons resulted in no difference (0%) or reductions in the occurrence  
5 of flow reductions between 28% to 42% (Table 11-1A-76).

6 **Table 11-1A-76. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
7 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
8 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-1	1
-85%	12	-42
-90%	-64	-28

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

9  
10 Comparisons for the American River at Nimbus Dam (Table 11-1A-77) and at the confluence with  
11 the Sacramento River (Table 11-1A-78) indicate negligible increases (2%) or substantial decreases  
12 (-1 to -60%) attributable to the project (Table 11-1A-77), with an increase of 14% for only one flow  
13 reduction category, 80% flow reduction, for the confluence.

1 **Table 11-1A-77. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-Over-Month Flow Reductions, American River at Nimbus**  
 3 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	33	-5
-75%	80	-6
-80%	245	-9
-85%	332	-15
-90%	214	5

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

4

5 **Table 11-1A-78. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
 7 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	4	-4
-75%	39	2
-80%	198	1
-85%	236	-4
-90%	289	-7

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

8

9 To evaluate water temperature-related effects of Alternative 1A on Pacific lamprey ammocoetes, we  
 10 examined the predicted number of ammocoete “cohorts” that experience water temperatures  
 11 greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature  
 12 data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers  
 13 over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each  
 14 individual day or month starts a new “cohort” such that there are 18,244 cohorts for the Sacramento  
 15 River, corresponding to 82 years of ammocoetes being “born” every day each year from January 1  
 16 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

17 In general, there would be no differences in the number of ammocoete cohorts exposed to  
 18 temperatures greater than 71.6°F in each river (Table 11-1A-79). There would be 24 more cohorts

1 (21% increase) exposed under Alternative 1A in the Trinity River at Lewiston, but there would be  
 2 32 fewer cohorts (10% decrease) exposed at North Fork. In addition, there would be 72 more  
 3 cohorts (14% increase) exposed under Alternative 1A in the Feather River below Thermalito  
 4 Afterbay, but there would be River at Fish Barrier Dam, but there would be 56 fewer cohorts (100%  
 5 decrease) exposed at North Fork. Overall, the small to moderate increases and decreases will  
 6 balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

7 **Table 11-1A-79. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey**  
 8 **Ammocoete Cohorts Exposed to Temperatures Greater than 71.6°F in at Least One Day or Month**

Location	EXISTING CONDITIONS	
	vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River at Keswick <sup>b</sup>	0 (NA)	1 (0.1%)
Sacramento River at Hamilton City <sup>b</sup>	5,299 (NA)	-274 (-2%)
Trinity River at Lewiston	56 (NA)	24 (21%)
Trinity River at North Fork	112 (NA)	-32 (-10%)
Feather River at Fish Barrier Dam	0 (NA)	-56 (-100%)
Feather River below Thermalito Afterbay	188 (49%)	72 (14%)
American River at Nimbus	258 (133%)	-14 (-2%)
American River at Sacramento River Confluence	151 (35%)	0 (0%)
Stanislaus River at Knights Ferry	0 (NA)	0 (0%)
Stanislaus River at Riverbank	282 (504%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Positive values indicate a higher value in Alternative 1A than in EXISTING CONDITIONS or NAA.

<sup>b</sup> Based on daily data; all other locations use monthly data; 1922–2003.

9

10 **NEPA Effects:** These results indicate that the effect would not be adverse because it would not  
 11 substantially reduce rearing habitat or substantially reduce the number of fish as a result of  
 12 ammocoete mortality. Alternative 1A would have negligible effects on temperature-related  
 13 ammocoete cohort survival for all locations, with a small increase (14%) in exposures to critical  
 14 temperatures in the Feather River below Thermalito Afterbay that would not be considered an  
 15 adverse effect. There would be beneficial effects from substantial decreases in the occurrence of  
 16 flow reductions in the Feather River and the American River.

17 **CEQA Conclusion:** In general, the quantity and quality of Pacific lamprey rearing habitat would not  
 18 be affected by Alternative 1A relative to the CEQA baseline. Lower flows can reduce the instream  
 19 area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality.  
 20 Comparisons of Alternative 1A to Existing Conditions for the Sacramento River at Keswick indicate  
 21 negligible changes (<5%) in occurrence of flow reductions for all flow reduction categories, except  
 22 the 80% reduction (9% increase in exposure risk) (Table 11-1A-73). Comparisons for the  
 23 Sacramento River at Red Bluff indicate that there would generally be no effect of A1A\_LLT, except in  
 24 the 70%, 80%, and 85% flow reductions (9%, 5%, and 100% increase in exposure risk, respectively)  
 25 (Table 11-1A-74).

26 Increases of 18% to 41% are predicted for flow reduction categories from 75% to 90% for the  
 27 Trinity River (Table 11-1A-75) based on increases from approximately 400 to 500 ammocoete  
 28 cohorts exposed to stranding risk.

1 The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under  
2 Alternative 1A would be higher than those under Existing Conditions in at least one location in all  
3 rivers (Table 11-1A-79).

#### 4 **Summary of CEQA Conclusion**

5 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that that the difference  
6 between the CEQA baseline and Alternative 1A could be significant because, under the CEQA  
7 baseline, the alternative could substantially reduce rearing habitat and substantially reduce the  
8 number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above.  
9 Increased exposure to elevated water temperature in the Sacramento, Feather, American, and  
10 Stanislaus Rivers would have biologically meaningful impacts on Pacific lamprey rearing habitat.  
11 Increased water temperatures would increase stress and reduce survival of lamprey ammocoetes.  
12 Increased stranding risk in the American and Trinity Rivers would increase the risk of desiccation  
13 and reduce survival of ammocoete cohorts.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
15 change, future water demands, and implementation of the alternative. The analysis described above  
16 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
17 the alternative from those of sea level rise, climate change and future water demands using the  
18 model simulation results presented in this chapter. However, the increment of change attributable  
19 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
20 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
21 implementation period, which does include future sea level rise, climate change, and water  
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
26 term implementation period and Alternative 1A indicates that flows and reservoir storage in the  
27 locations and during the months analyzed above would generally be similar between Existing  
28 Conditions during the LLT and Alternative 1A. This indicates that the differences between Existing  
29 Conditions and Alternative 1A found above would generally be due to climate change, sea level rise,  
30 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
31 1A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
32 therefore would not in itself result in a significant impact on rearing habitat for Pacific lamprey. This  
33 impact is found to be less than significant and no mitigation is required.

#### 34 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

35 In general, Alternative 1A would not affect the quality and quantity of migration habitat for Pacific  
36 lamprey relative to the NAA.

37 After 5–7 years, Pacific lamprey ammocoetes migrate downstream and become macrophthalmia  
38 (juveniles) once they reach the Delta. Migration generally is associated with large flow pulses in  
39 winter months (December through March) (USFWS unpublished data) meaning alterations in flow  
40 have the potential to affect downstream migration conditions. The effects of Alternative 1A on  
41 seasonal migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow  
42 output. Flow rates along the migration pathways of Pacific lamprey during the likely migration  
43 period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff,

1 the Feather River at the confluence with the Sacramento River, and the American River at the  
2 confluence with the Sacramento River.

### 3 **Sacramento River**

#### 4 *Juveniles*

5 The difference in mean monthly flow rate for the Sacramento River at Rio Vista for December to May  
6 for Alternative 1A compared to NAA indicates reductions in flow for most months/water year types  
7 in the migration period with persistent flow reductions ranging from 5% to 29% depending on the  
8 specific month and water year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
9 There would be decreases in flow during January to April (up to 22%) when reductions in flow  
10 would have the greatest effect on migration conditions. The decreases in flow in the Sacramento  
11 River at Rio Vista could adversely affect outmigrating macrophthalmia during these months.

12 For the Sacramento River at Red Bluff, the difference in mean monthly flow rate for Alternative 1A  
13 compared to NAA indicate generally negligible effects (<5%) on flow attributable to the project for  
14 December through April and increases in flow attributable to the project during April and May  
15 ranging from 6% to 14% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The  
16 increases in flow in the Sacramento River at Red Bluff would have a beneficial effect on migration  
17 conditions.

18 These results indicate that effects of Alternative 1A on flow consist of negligible effects (<5%), or  
19 small increases in flow that would have a beneficial effect on migration in the Sacramento River at  
20 Red Bluff, but that effects for Sacramento River at Rio Vista would consist primarily of reductions in  
21 flow, including during drier water years, for much of the macrophthalmia migration period that  
22 would adversely affect outmigrating macrophthalmia.

#### 23 *Adults*

24 For the Sacramento River at Red Bluff for the time-frame January to June (Appendix 11C, *CALSIM II*  
25 *Model Results utilized in the Fish Analysis*), effects of Alternative 1A on mean monthly flow indicate  
26 effects would typically be negligible (<5%) with small increases in flow (up to 16%) during April  
27 through June for some water years. Increases in flow would have a beneficial effect on migration  
28 conditions.

### 29 **Feather River**

#### 30 *Juveniles*

31 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,  
32 *CALSIM II Model Results utilized in the Fish Analysis*) indicate primarily increases in flow (up to 59%)  
33 for December through May. Increases in mean monthly flow would be beneficial for migration  
34 conditions.

#### 35 *Adults*

36 For the Feather River at the confluence with the Sacramento River, January to June (Appendix 11C,  
37 *CALSIM II Model Results utilized in the Fish Analysis*), mean monthly flows under Alternative 1A  
38 would generally be higher (up to 44%) than flows under NAA with few exceptions,

1 **American River**

2 *Juveniles*

3 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,  
4 *CALSIM II Model Results utilized in the Fish Analysis*) indicate negligible effects (<5%) of A1A\_LL  
5 relative to NAA during December through April. During May, flows under A1A\_LL would be up to  
6 32% greater than under NAA.

7 *Adults*

8 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
9 River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
10 indicate negligible effects (<5%) of A1A\_LL relative to NAA during January through April. During  
11 May and June, flows under A1A\_LL would be up to 34% greater than flows under NAA.

12 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
13 substantially reduce the amount of suitable habitat and substantially interfere with the movement of  
14 fish. Flows in the Sacramento River at Rio Vista under Alternative 1A would be reduced relative to  
15 NAA, with persistent flow reductions of 5% to 29% throughout the migration period that would  
16 affect conditions for outmigrating macrophthalmia at that location. However, this is the only location  
17 with such persistent negative effects on flows and negative effects on Pacific lamprey migration  
18 success would be offset by beneficial effects in the other locations analyzed. Effects of Alternative 1A  
19 in the other locations analyzed would consist primarily of negligible effects (<5%), that would not  
20 have biologically meaningful effects, and small-to-large (up to 59%) increases in flow that would  
21 have beneficial effects on migration conditions.

22 **CEQA Conclusion:** In general, Alternative 1A would not affect the quality and quantity of migration  
23 habitat for Pacific lamprey relative to CEQA Existing Conditions.

24 **Sacramento River**

25 *Juveniles*

26 Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista (Appendix 11C,  
27 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 1A relative  
28 to Existing Conditions indicate reductions in flow ranging from 5% to 47% in most water years for  
29 each of these months. These results indicate that effects of Alternative 1A on flow would have  
30 negative effects on outmigrating macrophthalmia in the Sacramento River. Comparisons for the  
31 Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
32 indicate primarily negligible (<5%) or small increases in flow (up to 18%) that would not have  
33 biologically meaningful effects on migration conditions. Exceptions include a decrease in flow of  
34 14% during May in wet years when flow reductions would not be as critical for migration  
35 conditions. Therefore, Alternative 1A would not have biologically meaningful negative effects on  
36 outmigrating macrophthalmia at this location.

37 *Adults*

38 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*  
39 *Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from  
40 January through June indicate that for most months and water year types, flows under Alternative

1 1A would be similar to (<5% difference), or greater (up to 21%) than flows under Existing  
2 Conditions, with one occurrence of decreased flow in wet years during May (14%) when effects of  
3 flow reductions would be less critical for migration. Therefore, effects of Alternative 1A consist of  
4 negligible effects or increases in flow that would have beneficial effects, and small reductions in flow  
5 that would not have biologically meaningful effects.

## 6 **Feather River**

### 7 *Juveniles*

8 Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized*  
9 *in the Fish Analysis*) for December to May indicate primarily increases in flow (up to 37%), with  
10 some infrequent conditions of negligible (<5%) or reduced flows (up to 23%). Reduced flow would  
11 occur in below normal water years in January (12% lower) and March (11% lower), and during wet  
12 years in May (23% lower). Increases in flow would have beneficial effects on migration conditions,  
13 while decreases would have negative effects on migration. Based on this limited occurrence of flow  
14 decreases at times that would be most critical for migration, and the prevalence of increased flows  
15 or negligible differences for most of the migration period, effects of Alternative 1A on flows would  
16 not have biologically meaningful effects on macrophthalmia migration in the Feather River.

### 17 *Adults*

18 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento  
19 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
20 indicate variable effects of Alternative 1A depending on the month and water year type, with  
21 primarily increased flow (to 39%) and negligible effects (<5%), which would have beneficial effects  
22 on migration conditions. However, the occurrence of relatively small decreases in flow (up to 23%),  
23 that would typically not have biologically meaningful effects on migration conditions. primarily  
24 occur in May and June. The more substantial decreases in flow would occur during below normal  
25 years in January (12% lower), and March (11% lower), wet years in May (9% lower) and June (19%  
26 lower), and in June during dry (7% lower) and critical years (17% lower). These flow reductions are  
27 isolated occurrences of relatively small magnitude and would therefore not have biologically  
28 meaningful effects on migration conditions. Therefore, effects of Alternative 1A on flow would not  
29 affect migration conditions in the Feather River.

## 30 **American River**

### 31 *Juveniles*

32 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,  
33 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable effects,  
34 primarily consisting of relatively small increases (up to 29%) or decreases (up to 27%) in flow,  
35 depending on month and water year type. Although these results were variable, the increased flows  
36 tended to occur in February (up to 29%) and March (up to 19%), and the decreased flows tended to  
37 occur in December (up to 24%), January (up to 27%) and May (up to 27%). Decreases in drier water  
38 years for December through March and May encompass much of the migration period and would  
39 affect macrophthalmia migration conditions for that time-frame (particularly critical years).

1 **Adults**

2 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
3 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
4 indicate variable effects of Alternative 1A depending on the month and water year type, with  
5 meaningful changes in flow ( $\geq\pm 5\%$ ) consisting of increases up to 32% (June, below normal years)  
6 that would have beneficial effects on migration conditions, and decreases to 37% in June of drier  
7 years. While the increased flows would occur more frequently in February and March, and  
8 decreased flows primarily in January and May, these two flow conditions would occur at about the  
9 same frequency and magnitude range over the adult migration period. Conclusions are that effects  
10 of Alternative 1A consist of variable effects on flow and predicted flow reductions would not have  
11 biologically meaningful effects on river lamprey migration based on the magnitude of the decreases  
12 and infrequent or isolated occurrences.

13 **Summary of CEQA Conclusion**

14 Collectively, these results indicate that the impact is not significant because it would not  
15 substantially reduce the amount of suitable habitat or substantially interfere with the movement of  
16 fish, and no mitigation is necessary. Effects of Alternative 1A compared to Existing Conditions  
17 during the January to June adult Pacific lamprey migration period consist of relatively small  
18 increases or decreases in flow, along with periodic negligible effects ( $<5\%$ ), that would not have  
19 biologically meaningful effects on migration conditions.

20 **Restoration Measures (CM2, CM4–CM7, and CM10)**

21 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

22 ***Temporary Increases in Turbidity***

23 Restoration construction activities such as riprap removal, shoreline excavation and re-contouring,  
24 and planting riparian vegetation have the potential to result in temporary increases in turbidity  
25 conditions in adjacent waterways. However, Pacific lamprey are tolerant of turbid water conditions  
26 and are unlikely to be affected by temporary increases in turbidity during restoration construction.  
27 Implementing the environmental commitments described under Impact AQUA-1 for delta smelt and  
28 in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
29 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
30 *Prevention, Containment, and Countermeasure Plan; Fish Rescue and Salvage Plan; and Barge*  
31 *Operations Plan)*, would minimize the potential for turbidity to affect Pacific lamprey.

32 ***Increased Exposure to Mercury***

33 As discussed above for delta smelt (Impact AQUA-7), the implementation of *CM12 Methylmercury*  
34 *Management* would minimize potential effects of methylmercury mobilization from restoration  
35 sites, on Pacific lamprey. As a result, restoration activities are not likely to produce the  
36 biogeochemical conditions that would support methylation of mercury; thus increased  
37 bioavailability and toxicity as a result of restoration activities are not expected. However, the cycling  
38 of mercury is a complicated process, and is difficult to predict based on existing information.

1       **Accidental Spills**

2       As discussed above for construction and maintenance activities (see Impact AQUA-1 and Impact  
3       AQUA-2 for delta smelt), implementation of environmental commitments would minimize the  
4       potential for introduction of contaminants to surface waters and provide for effective containment  
5       and cleanup should accidental spills occur. These environmental commitments are *Environmental*  
6       *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*  
7       *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of*  
8       *Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan*; (see Appendix  
9       3B, *Environmental Commitments* and Impact AQUA-1). Specifically, the *Spill Prevention, Containment,*  
10       *and Countermeasure Plan* will be implemented to minimize the risk of spills occurring and to provide  
11       for rapid and effective response to contain any accidental spills.

12       **Disturbance of Contaminated Sediments**

13       Runoff and suspension of contaminants could cause short-term, localized increases in the  
14       concentrations of contaminants in and near restoration sites (see discussion for delta smelt under  
15       Impact AQUA-7). The potential impacts of toxics on fish would be minimized to the extent possible  
16       by timing construction activities so that vulnerable early life stages of fish are not present. Although  
17       adult and ammocoete Pacific lamprey would likely be present during the expected in-water work  
18       window, implementation of environmental commitments (see Appendix 3B, *Environmental*  
19       *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Disposal of Spoils,*  
20       *Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan*) would minimize  
21       exposure levels. The periodic and temporary nature of toxicity spikes that may occur during  
22       restoration activities would also minimize the extent of potential effects on Pacific lamprey.  
23       Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt.

24       **In-Water Work Activities**

25       Restoration construction activities could temporarily produce noise levels and disturbances that  
26       could affect nearby fishes. Such activities are not expected to elevate underwater noise above the  
27       threshold sound pressure levels established for fish (see discussion for delta smelt under Impact  
28       AQUA-1). Any changes in disturbance levels would be minor and temporary, and fish are expected to  
29       generally avoid areas where shoreline construction activities are occurring. Potential effects of in-  
30       water activity would be minimized by implementation of the environmental commitments  
31       described under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*, including  
32       *Erosion and Sediment Control Plan; Dispose of Spoils, Reusable Tunnel Material, and Dredged Material;*  
33       *and Barge Operations Plan*. Pertinent details of these plans are provided under Impact AQUA-1 for  
34       delta smelt.

35       **Predation**

36       Although there is low certainty regarding their behavior in the Delta, lamprey macropthalmia likely  
37       use the Delta primarily as a migration corridor, as evidenced by low catches in beach seines in back  
38       sloughs and higher catches in beach seines in mainstem sampling (U.S. Fish and Wildlife Service  
39       2013). Only a small proportion of the proposed habitat restoration would be located along major  
40       migration corridors, such as the mainstem Sacramento and San Joaquin rivers, in the West and  
41       South Delta ROAs. Therefore, it is presumed that lamprey will not spend large amounts of time in the  
42       vicinity of restored tidal marsh or floodplain habitat while they are being constructed. Additionally  
43       any in-water work may cause predatory fish to temporarily avoid those locations reducing the

1 predation potential. Predation is not expected to increase. Therefore, the effect would not be  
2 adverse.

3 **NEPA Effects:** In-water and shoreline construction activities associated with habitat restoration  
4 would be scheduled to occur when the least number of Pacific lamprey would be present in or near  
5 the restoration sites. Such activities would include riprap removal and levee breaching, and  
6 shoreline excavation and re-contouring. Pacific lamprey are tolerant to increases in turbidity, which  
7 might occur during shoreline restoration construction activities. Implementation of the  
8 environmental commitments described in Appendix 3B, *Environmental Commitments*, would  
9 minimize or eliminate effects on Pacific lamprey smelt by reducing the amount of turbidity and  
10 guiding the rapid and effective response in case of inadvertent spills of hazardous materials (see  
11 Impact AQUA-7). These Environmental Commitments are *Environmental Training; Stormwater  
12 Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management  
13 Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel  
14 Material, and Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1  
15 for delta smelt. As a result, the effects of short-term restoration construction activities would not be  
16 adverse to longfin smelt.

17 While implementation of these environmental commitments would minimize or eliminate short-  
18 term effects occurring during restoration construction, long-term effects could also occur. For  
19 example, removing or breaching levees would result in the expansion of floodplain habitat, and  
20 more frequent inundation these areas, potentially promoting conversion of mercury to methylated  
21 mercury, and runoff containing agricultural-related toxins such as copper and organochlorine  
22 pesticides. However, the overall effect of increased bioavailability of methylmercury and other  
23 pollutants on Pacific lamprey is likely to be of low magnitude, periodic and localized. In addition,  
24 potential increases would be minimized to the extent possible because of implementation of *CM12  
25 Methylmercury Management* (see Impact AQUA-10). For these reasons, the effect on Pacific lamprey  
26 would not be adverse.

27 **CEQA Conclusion:** As described above, in-water and shoreline construction activities associated  
28 with habitat restoration would be scheduled to occur when the least number of Pacific lamprey  
29 would be present in or near the restoration sites. Pacific lamprey are tolerant to increases in  
30 turbidity, which might occur during shoreline restoration construction activities, and  
31 implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
32 and in Appendix 3B, *Environmental Commitments* (see *Environmental Training; Stormwater Pollution  
33 Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill  
34 Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,  
35 and Dredged Material*), would minimize the potential for turbidity, accidental spills, resuspension of  
36 contaminated sediments, or construction noise to affect Pacific lamprey. Therefore, this impact is  
37 considered less than significant for Pacific lamprey because it would not substantially reduce  
38 habitat, restrict its range or interfere with its movement. Consequently no mitigation would be  
39 required.

#### 40 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific** 41 **Lamprey**

42 **NEPA Effects:** As described above for delta smelt (see Impact AQUA-8), effects on covered fish  
43 species will depend on the species/life stage present in the area of elevated toxins and the duration  
44 of exposure. A complete analysis can be found in the *BDCP Effects Analysis – Appendix D*,

1 *Contaminants (hereby incorporated by reference)*. Potential impacts on lamprey from effects of  
2 methylmercury, selenium, copper, ammonia, and pesticides associated with habitat restoration  
3 activities would be similar to those discussed for delta smelt (see Impact AQUA-8).

4 As with delta smelt, the potential contaminants associated with habitat restoration activities are not  
5 expected to result in any adverse effects on lamprey (see detailed discussion for delta smelt under  
6 Impact AQUA-8). While Alternative 1A actions are likely to result in increased production,  
7 mobilization, and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic  
8 system, any such releases would be sporadic, short term and localized, and would be unlikely to  
9 result in measurable increases in the bioaccumulation in Pacific lamprey. In addition,  
10 implementation of *CM12 Methylmercury Management* would help to minimize the increased  
11 mobilization of methylmercury at restoration areas. In addition, the overall effects associated with  
12 habitat restoration are expected to result in an overall benefit to Pacific lamprey.

13 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
14 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
15 However, any such releases would be sporadic, short-term and localized, and would be unlikely to  
16 result in measurable increases in the bioaccumulation in Pacific lamprey. Implementation of *CM12*  
17 *Methylmercury Management* would also help to minimize the increased mobilization of  
18 methylmercury at restoration areas. Therefore, the impact of contaminants is considered less than  
19 significant because it would not substantially effect Pacific lamprey either directly or through  
20 habitat modifications and, with restoration, would be beneficial in the long-term. Consequently, no  
21 mitigation would be required.

## 22 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

23 The full analysis of habitat restoration can be found in the *BDCP Effects Analysis – Appendix E,*  
24 *Habitat Restoration (hereby incorporated by reference)*. As analyzed further below, the proposed  
25 tidal marsh, channel margin, floodplain, and riparian restoration measures are intended to increase  
26 access to suitable habitat for Pacific and river lamprey, as well as other covered fish species, and  
27 restore important ecological functions of the Delta. For further discussion see Impact AQUA-9 for  
28 delta smelt.

29 Little is known about the occurrence and potential function of various habitat types to Pacific  
30 lamprey in the Plan Area. As described above, there have been occasional catches of lamprey during  
31 seine surveys and more than 2,100 Pacific lamprey ammocoetes were collected during  
32 electrofishing at bank protection sites (H.T. Harvey and Associates with PRBO Conservation Science  
33 2011). Lamprey ammocoetes generally are thought of as occurring upstream of the Plan Area, but  
34 there appear also to be appreciable numbers in the Plan Area. Enhancement of channel margin  
35 habitat would increase the amount of ammocoete burial habitat where hardened substrates are  
36 removed or covered with soft substrate of a sufficient depth (at least 30 cm) (Close et al. 2003).

## 37 **CM2 Yolo Bypass Fisheries Enhancement**

38 Yolo Bypass fisheries enhancement is discussed above under delta smelt (Impact AQUA-9). Pacific  
39 lamprey do not substantially use floodplains so the increase in this habitat would have limited  
40 beneficial effect on Pacific lamprey.

1 **CM4 Tidal Natural Communities Restoration**

2 Little is known about the occurrence and potential function of tidal wetland habitat to Pacific  
3 lamprey in the Plan Area. However, the increase in habitat area may help to increase species  
4 diversity and abundance. For further discussion, see Impact AQUA-9. Increased food productivity is  
5 expected in all ROAs as a result of the BDCP. A phytoplankton growth model was developed to  
6 estimate the change in food production expected from tidal restoration in the ROAs. The model was  
7 based on a strong relationship between phytoplankton growth rate and depth, but could not be  
8 extended to zooplankton production (the primary food of many of the covered fish), due to  
9 uncertainty in that relationship and the unknown effects of invasive filter feeders such as the Asian  
10 clam. However, overall primary productivity is assumed to translate directly to increases in food  
11 production for lamprey ammocoetes, which are filter feeders.

12 **CM5 Seasonally Inundated Floodplain Restoration**

13 Pacific lamprey do not substantially use floodplains, so the increase in this habitat would have  
14 limited beneficial effect on Pacific lamprey. However, periodic inundation of the restored floodplain  
15 would likely benefit lamprey by cycling nutrients, supporting growth of plankton and aquatic  
16 insects. Providing river–floodplain connectivity would increase production of lower trophic levels at  
17 relatively rapid time scales, with some food web organisms responding within days at high  
18 densities. For further discussion see Impact AQUA-9.

19 Although food is not likely a limiting factor to the abundance of lamprey in the Delta, BDCP actions,  
20 notably the restoration and enhancement of upstream habitats, may increase lamprey food  
21 availability relative to Existing Conditions. If the upstream productivity transfer occurs at the  
22 planktonic level, lamprey ammocoetes would directly benefit. For further discussion, see Impact  
23 AQUA-9.

24 **CM6 Channel Margin Enhancement**

25 Although little is known about lamprey use of channel margin habitat, the species may benefit from  
26 enhancement that increases the area of non-revetted substrate into which ammocoetes can bury;  
27 recent monitoring indicates that ammocoetes may be relatively abundant in the substrates in the  
28 Plan Area

29 Lamprey spawn upstream of the Plan Area and so would not likely benefit from an increase in  
30 spawning habitat under *CM6 Channel Margin Enhancement*.

31 However, CM6 Channel Margin Enhancement is expected to increase the availability and quality of  
32 resting habitat for migrating lamprey as a result of increased channel margin complexity (e.g.,  
33 woody material) providing refuge from high flows. The benefits of this increased resting habitat are  
34 uncertain because of a lack of research on lamprey migration behavior.

35 **CM7 Riparian Natural Community Restoration**

36 BDCP habitat restoration, including riparian restoration, are expected to improve the quality and  
37 quantity of Delta rearing habitats for lamprey. Once established, these habitats could provide  
38 suitable food resources for lamprey. However, it is uncertain whether lamprey would directly  
39 benefit for riparian restoration (*CM7 Riparian Natural Community Restoration*). For further  
40 discussion, see Impact AQUA-9.

1 **CM10 Nontidal Marsh Restoration**

2 For discussion of the potential effects of nontidal marsh restoration on Pacific lamprey, see the  
3 discussion under Impact AQUA-9. Upland restoration could have minor indirect beneficial effects on  
4 Pacific lamprey in the main river systems and Delta. These upland wetlands provide hydrologic and  
5 water quality functions such as storing water during floods and filtering contaminants. These sites  
6 would also provide some additional food resources such as insects, zooplankton, phytoplankton and  
7 dissolved organic carbon. These materials would be exported during flood stages when the upland  
8 might be connected to the river system. Although the contribution from 400 acres would be small, it  
9 could be slightly beneficial.

10 **NEPA Effects:** The effects of floodplain, tidal, channel margin and riparian habitat restoration  
11 activities on Pacific lamprey, are expected to be similar to those discussed for delta smelt (see  
12 Impact AQUA-9). In general, these effects are expected to have limited benefits for lamprey, with the  
13 primary benefits likely to be the result of increased productivity from more frequent inundations of  
14 restoration areas and increased amount and quality of available rearing and migration habitat.

15 Despite the improvements in habitat and habitat functions in the Delta from these habitat  
16 restoration activities, habitat quality is expected to decline in the LLT primarily because of climate  
17 change. However, the overall effect of restoration activities is expected to remain beneficial for  
18 lamprey.

19 However, it is important to note that benefits would not be derived in all years, and that an adaptive  
20 management plan would be needed to determine an operational protocol that optimizes benefits  
21 both locally and in adjacent habitats.

22 **CEQA Conclusion:** As with delta smelt, the overall effects of floodplain, tidal, channel margin and  
23 riparian habitat restoration activities are expected to be beneficial for lamprey (see Impact AQUA-  
24 9). The primary benefits are likely to be the result of increased productivity from more frequent  
25 inundations of restoration areas and increased amount and quality of available rearing and  
26 migration habitat. Despite the improvements in habitat and habitat functions in the Delta from these  
27 habitat restoration activities, habitat quality is expected to decline in the LLT primarily because of  
28 climate change. However, the overall impact of restoration activities is expected to remain beneficial  
29 for lamprey because they increase habitat. Consequently, no mitigation would be required.

30 **Other Conservation Measures (CM12–CM19 and CM21)**

31 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

32 Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of methylmercury  
33 management on Pacific lamprey.

34 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**  
35 **(CM13)**

36 The following analysis is based on the more detailed analysis included in *BDCP Effects Analysis –*  
37 *Appendix F, Biological Stressors, Section F.1.1 Invasive Aquatic Vegetation, Section F.4 Invasive Aquatic*  
38 *Vegetation, and F.5.3.2.3 Nonnative Aquatic Vegetation Control (Conservation Measure 13) (hereby*  
39 *incorporated by reference).*

1 **NEPA Effects:** A general analysis of the effects on covered fish species has been conducted that was  
2 described above for delta smelt (see Impact AQUA-11). Potential impacts on Pacific lamprey from  
3 IAV control during operations are similar to those discussed for delta smelt. The control of IAV with  
4 implementation of *CM13 Invasive Aquatic Vegetation Control* is expected to maintain or improve  
5 turbidity conditions that could benefit Pacific lamprey rearing conditions. The control of IAV would  
6 also increase the amount of rearing habitat, as well as access to the habitat and potential increases  
7 in food availability. Removal of IAV would reduce habitat supporting predatory fish. The effects of  
8 IAV control are expected to provide an overall benefit to Pacific lamprey.

9 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to Pacific lamprey during  
10 operations through chemical and mechanical treatment and is considered a beneficial impact by  
11 reducing predation mortality, increasing food availability, and increasing rearing habitat. The impact  
12 is expected to be beneficial; consequently, no mitigation would be required.

### 13 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

14 **NEPA Effects:** As discussed in Chapter 8, *Water Quality*, dissolved oxygen levels would be very  
15 similar to Existing Conditions in the areas upstream of the Delta, in the Delta, and in the SWP/CVP  
16 export service areas (see discussion of Impacts WQ-10 and WQ-11). As noted there, however, *CM14*  
17 *Stockton Deepwater Ship Channel Dissolved Oxygen Levels* management would increase the dissolved  
18 oxygen levels and improve the aquatic habitat conditions. Pacific lamprey occur in the channel and  
19 the increased dissolved oxygen levels also provide improved habitat conditions for them, which  
20 would be a benefit. Consequently, the effect would not be adverse, and could be slightly beneficial.

21 **CEQA Conclusion:** As discussed in Chapter 8, *Water Quality*, *CM14 Stockton Deepwater Ship Channel*  
22 *Dissolved Oxygen Levels* management would increase the dissolved oxygen levels and improve  
23 aquatic habitat conditions. Pacific lamprey occur in the channel and the increased dissolved oxygen  
24 levels also provide improved habitat conditions for them, which would be beneficial. Consequently,  
25 no mitigation would be required

### 26 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey** 27 **(CM15)**

28 Adult lamprey are generally not preyed on by other fish in the Delta. Juvenile Pacific lamprey  
29 (macrothemia life stage) would be expected to pass through the channel rapidly limiting the  
30 opportunity for larger fish to prey on them. Previous diet studies (Stevens 1966; Nobriga and Feyrer  
31 2007) did not find a single Pacific lamprey in the gut of striped bass, largemouth bass, or  
32 Sacramento pikeminnow, despite examining thousands of predator guts (9,197 striped bass, 320  
33 largemouth bass, and 322 pikeminnow combined in the two studies). However, the sampling  
34 periods of these studies (Stevens 1966: February–November; Nobriga and Feyrer 2007: March–  
35 October) did not generally overlap with peak lamprey migration periods. Approximately 79% of  
36 lamprey salvage between 1993 and 2004 at state and federal facilities occurred during January and  
37 February (California Department of Fish and Wildlife 2013c). Therefore, it is assumed that predation  
38 of lamprey occurs in the Delta, although there is low certainty of the effect that predation has on the  
39 species. To the extent that localized predator control efforts of *CM15 Localized Reduction of*  
40 *Predatory Fish* reduce the overall abundance of fish predators in the Delta occupied by Pacific  
41 lamprey, it is possible, but not assured that there would be some reduction in losses to predation,  
42 (see Impact AQUA-13).

1 **NEPA Effects:** Due to these uncertainties, there would be no demonstrable effect of this conservation  
2 measure on Pacific lamprey.

3 **CEQA Conclusion:** Due to the uncertainties concerning overall fish predator reduction and actual  
4 predation reduction on Pacific lamprey in the Delta, there would be no demonstrable effect on this  
5 conservation measure on Pacific lamprey. Consequently, no mitigation would be required.

#### 6 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

7 **NEPA Effects:** Effects on lamprey species from predation associated with construction of NPBs are  
8 unknown. Pacific lamprey are known to inhabit reaches of the Sacramento and San Joaquin River  
9 basins upstream of the Delta, so they would encounter the NPBs at Georgiana Slough and the head of  
10 Old River. The NPBs are likely to attract piscivorous predators hiding among the physical structures  
11 of the barrier. Unlike salmon, lamprey are not deterred by the sounds and lights of the barrier, and  
12 therefore are not deterred from entering areas of the Delta associated with high predation.  
13 Implementation of *CM16 Nonphysical Fish Barriers* is expected to be generally ineffective with  
14 lamprey. The additional predation on Pacific lamprey would be expected to be low and the  
15 population level effect would not be adverse.

16 **CEQA Conclusion:** Effects on lamprey species from predation associated with construction of NPBs  
17 is uncertain. The NPBs are likely to attract piscivorous predators hiding among the physical  
18 structures of the barrier. Unlike salmon, lamprey are not deterred by the sounds and lights of the  
19 barrier, and therefore are not deterred from entering areas of the Delta associated with high  
20 predation. Implementation of *CM16 Nonphysical Fish Barriers* is expected to be generally ineffective  
21 with lamprey. The additional predation on Pacific lamprey is expected to be low. The overall impact  
22 on Pacific lamprey from NPBs is less than significant because it would not substantially reduce their  
23 numbers. Consequently, the impact would be less than significant. No mitigation would be required.

#### 24 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

25 **NEPA Effects:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central Valley  
26 steelhead, green sturgeon and white sturgeon and are expected to have positive effects on their  
27 populations. Since this conservation measure is not applied to Pacific lamprey it would have no  
28 direct effect on them. Therefore, the effect would not be adverse.

29 **CEQA Conclusion:** *CM17 Illegal Harvest Reduction* would be applied to Chinook salmon, Central  
30 Valley steelhead, green sturgeon and white sturgeon and are expected to have positive effects on  
31 their populations. Since this conservation measure is not applied to Pacific lamprey it would have no  
32 direct effect on them. Consequently, no mitigation would be required.

#### 33 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

34 **NEPA Effects:** *CM18 Conservation Hatcheries* would establish new and expand existing conservation  
35 propagation programs for delta and longfin smelt. This conservation measure would have no effect  
36 on Pacific lamprey.

37 **CEQA Conclusion:** *CM18 Conservation Hatcheries* would establish new and expand existing  
38 conservation propagation programs for delta and longfin smelt. This conservation measure would  
39 have no impact on Pacific lamprey. Consequently, no mitigation would be required.

1 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

2 **NEPA Effects:** The effects of *CM19 Urban Stormwater Treatment* would reduce contaminants  
3 associated with urban areas because it provides for the treatment of stormwater discharges. As  
4 discussed in Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled  
5 *Pyrethroids, Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment  
6 would reduce urban loadings of pesticides (including pyrethroids), phosphorous, trace metals and  
7 other contaminants. These reductions would contribute to improved water quality in the Delta.  
8 Based on the improved overall water quality conditions and reduced pesticides the effect would be  
9 beneficial.

10 **CEQA Conclusion:** *CM19 Urban Stormwater Treatment* would reduce contaminants associated with  
11 urban areas because it would provide for the treatment of stormwater discharges. As discussed in  
12 Chapter 8, *Water Quality*, and previously under Impact AQUA-8 in the section titled *Pyrethroids,*  
13 *Organophosphate Pesticides, and Organochlorine Pesticides*, stormwater treatment would reduce  
14 urban loadings of pesticides(including pyrethroids), phosphorous, trace metals and other water  
15 contaminants. These reductions would contribute to improved water quality in the Delta. Therefore,  
16 the impacts of urban stormwater treatment would be beneficial because it would have a beneficial  
17 effect both directly and through habitat modifications on Pacific lamprey. Consequently, no  
18 mitigation would be required.

19 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
20 **Lamprey (CM21)**

21 **NEPA Effects:** As discussed above for other species, there is no evidence of substantial entrainment  
22 of covered fish species at agricultural diversions in the Plan Area, although slight reductions are  
23 expected from decommissioning agricultural diversions in the ROAs (see Impact AQUA-18). The  
24 effect would be beneficial.

25 **CEQA Conclusion:** Although there is no evidence of substantial entrainment of covered fish species  
26 at agricultural diversions in the Plan Area, slight reductions are expected from decommissioning  
27 agricultural diversions in the ROAs (see Impact AQUA-18). The impact on Pacific lamprey would be  
28 beneficial because it would reduce entrainment which would have a positive impact on Pacific  
29 lamprey numbers. Consequently, no mitigation would be required.

30 **River Lamprey**

31 **Construction and Maintenance of CM1**

32 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

33 River lamprey are present in the north, east, and south Delta. Table 11-4 illustrates the life stages of  
34 river lamprey present in these areas during the in-water construction window (expected to be June  
35 1–October 31). Ammocoetes are present year-round in all of these areas. Adult spawners may be  
36 migrating by construction sites for the intakes and barge landings during September and October.  
37 Macrothalmia (migrating juveniles) may be in the north and south Delta in June and July.

38 **Temporary Increases in Turbidity**

39 River lamprey ammocoetes, adults, and migrating juveniles may occur in the area during  
40 construction of the intake structures and barge landings. Because river lamprey typically inhabit

1 turbid water, they are unlikely to be affected by a temporary increase in turbidity. As discussed for  
2 delta smelt (see Impact AQUA-1), environmental commitments would be implemented to minimize  
3 turbidity during construction activities (see Impact AQUA-1 and Appendix 3B, *Environmental*  
4 *Commitments Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
5 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
6 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
7 *and Salvage Plan; and Barge Operations Plan*). Pertinent details of these plans are provided under  
8 Impact AQUA-1 for delta smelt.

#### 9 **Accidental Spills**

10 Potential impacts on river lamprey from accidental spills during construction are similar to those  
11 discussed for delta smelt (see Impact AQUA-1). Implementing the environmental commitments  
12 described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*  
13 *(Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*  
14 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan)*,  
15 and specifically the *Spill Prevention, Containment, and Countermeasure Plan*, would be expected to  
16 minimize the potential for introduction of contaminants to surface waters and provide for effective  
17 containment and cleanup should accidental spills occur.

#### 18 **Disturbance of Contaminated Sediments**

19 There is a potential risk of contaminated sediments affecting river lamprey during construction of  
20 intake structures and barge landings. Because they are filter feeders and are buried in the substrate,  
21 the ammocoetes could be the most affected life stage by the disturbance of sediment contaminants.  
22 However, the suspension of sediments would be minimized by implementation of environmental  
23 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
24 *Commitment, (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
25 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
26 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
27 *and Salvage Plan; and Barge Operations Plan*). Pertinent details of these plans are provided under  
28 Impact AQUA-1 for delta smelt.

#### 29 **Underwater Noise**

30 Underwater sound generated by impact pile driving in or near surface waters can potentially harm  
31 river lamprey. It is important to note that the impact would be realized only where piles must be  
32 impact driven; underwater sound generated by vibratory pile installation methods are not  
33 sufficiently loud to injure fish.

34 Potential effects on river lamprey from pile driving are different from other fish species. In a study  
35 done by Popper (2005) on hearing by sturgeon and lamprey, it was found that lamprey do not have  
36 the typical hearing structures of other fish. While there have been no definitive studies to determine  
37 responses of lamprey to sound (Popper 2005), ammocoetes are buried below the substrate, and the  
38 substrate dampens vibrations and noise. As a result, at least some life stages of river lamprey may be  
39 somewhat less susceptible to injury from impact pile driving activities, than other fish species.  
40 Implementation of Mitigation Measures AQUA-1a and AQUA-1b would also reduce the severity of  
41 these effects. Overall, construction noise would be expected to adversely affects individual lamprey,  
42 although the effects are not expected to affect the overall population.

1 **Fish Stranding**

2 In-water work activities have the potential to injure or kill fish through the process of rescuing fish  
3 from construction areas. River lamprey adults may be present from September through June.  
4 Outmigrating juveniles (macrothemia life stage) also pass through the area from May to July, but in  
5 small numbers. Although adult river lamprey may be present during cofferdam installation, some  
6 may avoid the noise and disturbance associated with cofferdam installation. Ammocoetes could  
7 emerge during cofferdam installation and might need to be rescued and removed. Fish removal  
8 activities from construction areas would be implemented according to environmental commitment  
9 *Fish Rescue and Salvage Plan*, as described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
10 *Environmental Commitments*. Pertinent details of this plan are discussed under Impact AQUA-1 for  
11 delta smelt. Because of these measures, the risk of substantial effects would be minimized.

12 **In-Water Work Activities**

13 As discussed for delta smelt (see Impact AQUA-1), in-water work activities have the potential to  
14 disturb, injure or kill fish through direct physical injury from construction activities. Although some  
15 fish may avoid the noise and activity of pile installation and placement of riprap protection, these  
16 activities have the potential to injure or kill fish. River lamprey ammocoetes are buried in the  
17 substrate and are likely to stay under the substrate unless directly disturbed. The installation of  
18 sheet piles, support piles, and riprap has the potential to injure or kill lamprey ammocoetes, which  
19 are displaced by other construction activities. Due to the low number of lamprey or their  
20 ammocoetes expected in these locations, and implementation of environmental commitment *Fish*  
21 *Rescue and Salvage Plan*, as described under Impact AQUA-1 and in Appendix 3B, *Environmental*  
22 *Commitments*. Because of these measures, the risk of substantial effects would be minimized.

23 **Loss of Spawning, Rearing, or Migration Habitat**

24 The habitat affected by construction activities is used by river lamprey for migration and possibly  
25 rearing, depending on the specific site conditions. No spawning habitat is present for river lamprey  
26 in the project areas. Because only about 10% of the river cross section would be blocked by the  
27 cofferdams, fish passage would be relatively unaffected, and there would be no substantial loss of  
28 river lamprey migration habitat. Rearing habitat would be lost because of construction of permanent  
29 structures. However, other rearing habitat of similar quantity and quality is available for  
30 ammocoetes in the Sacramento River.

31 The construction of the intakes and barge landings will temporarily affect river lamprey migration  
32 and rearing habitat, and the intakes will permanently alter the nearshore portion of this habitat in  
33 the Sacramento River. Because of implementation of *CM6 Channel Margin Enhancement*, the overall  
34 effects would be limited because of the relatively poor quality of the current habitat, and the  
35 enhancement or addition of new, higher quality habitat associated with *CM6 Channel Margin*  
36 *Enhancement*. Furthermore, environmental commitments described under Impact AQUA-1 and in  
37 Appendix 3B, *Environmental Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of*  
38 *Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*, would minimize  
39 potential effects. Pertinent measures included in these plans are discussed under Impact AQUA-1 for  
40 delta smelt.

1 **Predation**

2 Adult lamprey are generally not preyed upon by other fish in the Delta. Juvenile river lamprey  
3 (macrothemia life stage) pass rapidly through the Delta, limiting the opportunity for larger fish to  
4 prey on them while they are in freshwater. Consequently, the addition of structures in the river and  
5 sloughs that could provide habitat for predatory fishes would likely result in a negligible effect on  
6 river lamprey.

7 **Summary**

8 Ammocoetes (larvae) are present year-round in all of the regions, and adult spawner and  
9 macrothemia life stages may be migrating by the construction sites during the in-water  
10 construction window in all Delta subregions. Overall, the potential effects of project construction  
11 activities would be very similar to those described for Pacific lamprey (see Impact AQUA-163).  
12 Implementation of the environmental commitments described under Impact AQUA-1 and in  
13 Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
14 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
15 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
16 *and Dredged Material)*, would minimize effects of construction activities related to turbidity,  
17 accidental spills, onsite and offsite sediment transport to surface waters, and re-suspension and  
18 redistribution of potentially contaminated sediments for river lamprey. Pertinent details of these  
19 plans are provided under Impact AQUA-1 for delta smelt.

20 **NEPA Effects:** As a result, these effects could be adverse to individuals, but would not be adverse to  
21 river lamprey populations.

22 **CEQA Conclusion:** As discussed above, and for Pacific lamprey (see Impact AQUA-163),  
23 implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
24 and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
25 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
26 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
27 *and Dredged Material)*, would minimize effects of construction activities related to turbidity,  
28 accidental spills, onsite and offsite sediment transport to surface waters, and re-suspension and  
29 redistribution of potentially contaminated sediments for river lamprey. Although only a limited  
30 occurrence of river lamprey is expected in the construction areas, the direct effects of underwater  
31 construction noise on them would be a significant impact because of the high likelihood that it  
32 would cause injury or death to some fish in the immediate vicinity of the activity. However,  
33 Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for effects from underwater  
34 noise and would reduce the severity of impacts to a less-than-significant level. As a result, the  
35 overall construction effects are considered less than significant, and no additional mitigation would  
36 be required.

37 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
38 **of Pile Driving and Other Construction-Related Underwater Noise**

39 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 for delta smelt.

40 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
41 **and Other Construction-Related Underwater Noise**

42 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 for delta smelt.

1 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

2 ***Temporary Increases in Turbidity***

3 As discussed for construction-related effects on turbidity (Impact AQUA-1), the potential increases  
4 in turbidity would be minimized to the extent possible through implementation of environmental  
5 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
6 *Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment*  
7 *Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
8 *Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue*  
9 *and Salvage Plan; and Barge Operations Plan)*. Pertinent details of these plans are provided under  
10 Impact AQUA-1 for delta smelt. In addition, river lamprey are tolerant of turbid conditions, and  
11 maintenance activities would be conducted when the least numbers of river lamprey are likely to be  
12 present.

13 ***Accidental Spills***

14 Maintenance activities such as dredging, levee repair and placement of riprap could accidentally  
15 introduce contaminants into the aquatic environment. Effects would be minimized by implementing  
16 the environmental commitments described under Impact AQUA-1 and in Appendix 3B,  
17 *Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan;*  
18 *Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention,*  
19 *Containment, and Countermeasure Plan)*. Pertinent details of these plans are provided under Impact  
20 AQUA-1 for delta smelt. Additionally, the limited frequency and duration of in-water maintenance  
21 would reduce the likelihood of any significant contaminant input to the Sacramento River and  
22 potential effects on river lamprey survival.

23 ***Underwater Noise***

24 As discussed for delta smelt (see Impact AQUA-2), underwater noise levels produced by in-water  
25 maintenance activities are not expected to reach a level that would harm juvenile or adult lamprey.  
26 NMFS has found that underwater sound pressure levels less than the 150 dB RMS behavioral effects  
27 threshold may result in temporary altered behavior of fishes indicative of stress but would not  
28 result in permanent harm or injury (National Marine Fisheries Service 2001). Any increases in  
29 underwater noise would be temporary and infrequent, and would occur when the least number of  
30 river lamprey are likely to be present.

31 ***Maintenance-Related Disturbance***

32 Direct injury and mortality of river lamprey from the use of in-water equipment during maintenance  
33 are most likely to occur during dredging activities around the new intakes. Suction dredging and  
34 mechanical excavation can capture or crush fish, causing injury or mortality. river lamprey  
35 ammocoetes are present year-round in the Sacramento River. The ammocoetes may use both main  
36 channel areas and nearshore areas for rearing and migration. Because river lamprey ammocoetes  
37 are buried in sediment, they may become entrained in the dredge. Maintenance dredging would take  
38 place when river lamprey ammocoetes are in the area (they are present year-round). The number of  
39 river lamprey ammocoetes that could be affected by dredging is unknown. However, because  
40 maintenance dredging would occur infrequently, for a short duration, and in limited areas, in-water  
41 maintenance activities would not affect river lamprey populations. Furthermore, effects would be  
42 minimized by implementation of environmental commitments including *Environmental Training;*

1 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials*  
2 *Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Barge Operations*  
3 *Plan, described under Impact AQUA-1 for delta smelt and in Appendix 3B, Environmental*  
4 *Commitments.*

#### 5 ***Loss of Spawning, Rearing, or Migration Habitat***

6 River lamprey habitat near the intake structures is available for rearing and migration. Dredging  
7 would remove rearing habitat, especially if ammocoetes were present in the dredging footprint.  
8 Placing riprap on the bank would likely have limited effects on available rearing habitat. Migration  
9 habitat would not be substantially affected by dredging or riprap placement, and additional  
10 migration habitat is available farther out in the channel. Maintenance activities would have limited  
11 effects on overall rearing habitat, because available rearing habitat of similar quality is readily  
12 accessible to river lamprey. Furthermore, effects would be minimized by implementation of  
13 environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
14 *Environmental Commitments.*

#### 15 ***Predation***

16 Adult lamprey are generally not preyed on by other fish in the Delta. Juvenile river lamprey  
17 (macrothemia life stage) pass rapidly through the Delta, limiting the opportunity for larger fish to  
18 prey on them while they are in freshwater. Maintenance activities would be unlikely to have any  
19 measurable effect on river lamprey predation rates. These activities may include the use of barges  
20 and other watercraft that could theoretically provide cover, shelter, and perching areas for delta  
21 smelt predators. However, the limited duration of maintenance activities and the associated noise  
22 and disturbance would be expected to dissuade predators from concentrating at sufficient density to  
23 measurably affect predation rates on river lamprey.

#### 24 ***Summary***

25 River lamprey are tolerant to increases in turbidity, which might occur during maintenance  
26 activities. Such activities would include maintenance dredging at the intake sites, and installation or  
27 repair of riprap bank armoring. Implementation of the environmental commitments described  
28 under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*, would  
29 further minimize or eliminate effects of turbidity, and accidental spills to river lamprey by limiting  
30 turbidity increases, and by guiding the rapid and effective response in the case of inadvertent spills  
31 of hazardous materials. These environmental commitments are *Environmental Training; Stormwater*  
32 *Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management*  
33 *Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel*  
34 *Material, and Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1  
35 for delta smelt. In addition, underwater noise levels generated by maintenance activities are  
36 unlikely to affect lamprey.

37 While maintenance dredging would remove rearing habitat, especially if ammocoetes use habitat in  
38 the dredging footprint, placing riprap on the bank would likely have limited effects on available  
39 rearing habitat, because similar quality habitat is readily accessible to river lamprey. Migration  
40 habitat would not be substantially affected by dredging or riprap placement, and additional  
41 migration habitat is available farther out in the channel. In addition, no spawning habitat occurs in  
42 the areas potentially affected by maintenance activities, and ample rearing, and migration habitat of

1 the same quality is readily accessible in the area, and this habitat would not be affected by  
2 maintenance activities.

3 **NEPA Effects:** The effects of short-term maintenance activities would not be adverse to river  
4 lamprey.

5 **CEQA Conclusion:** As described above, river lamprey are tolerant to increases in turbidity, and  
6 implementation of the environmental commitments described under Impact AQUA-1 for delta smelt  
7 and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*  
8 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*  
9 *Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material,*  
10 *and Dredged Material)*, would minimize or eliminate effects of turbidity, as well as potential effects  
11 from accidental spills to river lamprey. In addition, underwater noise levels generated by  
12 maintenance activities are unlikely to affect lamprey.

13 While maintenance dredging would remove rearing habitat, especially if ammocoetes use habitat in  
14 the dredging footprint, effects would be limited because similar quality habitat is readily accessible  
15 to river lamprey. Migration habitat would not be substantially affected by maintenance activities,  
16 and no spawning habitat occurs in these areas. In addition, ample rearing and migration habitat of  
17 the same quality is readily accessible in areas that would not be affected by maintenance activities.  
18 Accordingly, the effects of short-term maintenance activities would be less than significant because  
19 it would not reduce river lamprey habitat, restrict its range, or interfere with its movement.  
20 Consequently, no mitigation would be required.

## 21 **Water Operations of CM1**

### 22 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

#### 23 ***Water Exports from SWP/CVP South Delta Facilities***

24 Alternative 1A is expected to result in decreased entrainment of Pacific and river lamprey  
25 macrothemia and adults at the south Delta export facilities compared to NAA. The estimated level of  
26 reduction (approximately 50%) is based solely on the assumption that proportional changes in flow  
27 lead to similar proportional changes in entrainment.

28 The analysis for Pacific and river lamprey was combined because the CVP and SWP fish salvage  
29 facilities do not distinguish between the two species (see discussion for Pacific lamprey in Impact  
30 AQUA-165).

#### 31 ***Water Exports from SWP/CVP North Delta Intake Facilities***

32 The analysis for Pacific and river lamprey was combined because the CVP and SWP fish salvage  
33 facilities do not distinguish between the two species (see discussion for Pacific lamprey in Impact  
34 AQUA-165).

#### 35 ***Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct***

36 Entrainment of river lamprey at the North Bay Aqueduct has not been explicitly analyzed. However,  
37 the Barker Slough Pumping Plant is screened for fish >25mm although lamprey would be longer  
38 than this because of their body shape. The alternative intake would presumably have screens of  
39 1.75-m mesh and therefore it would exclude lamprey >50-60 mm based on north Delta intake

1 analysis (as evaluated in *BDCP Effects Analysis – Appendix 5B, Entrainment, Section B.5.9.2.1*  
2 *Screening Effectiveness Analysis, hereby incorporated by reference*). Overall effects would be expected  
3 to be no greater than for delta smelt.

4 If unforeseen changes in distributions or other factors occur as a result of project operations that  
5 would increase the proportional loss of river lamprey to entrainment, monitoring and the BDCP-  
6 proposed Real-Time Response Team would implement measures to avoid or minimize any potential  
7 threats to the species that might occur. Based on the current analysis, this would not be necessary.

8 **NEPA Effects:** Based on the projected entrainment (salvage rates) of river lamprey under the BDCP,  
9 a substantial reduction is expected at the south Delta facilities. However, the potential entrainment  
10 of juvenile lamprey at the north Delta facility raises some uncertainty of the overall change in  
11 entrainment rate. This uncertainty will be addressed through monitoring and adaptive management  
12 actions. The project adaptive management plan includes monitoring of the new north Delta screens  
13 to determine their effectiveness and if they are not meeting expectations additional measures (i.e.,  
14 modifications to screens or other structural components or changes in water diversion operations)  
15 may be implemented to improve screen performance. Based on available information, overall  
16 entrainment effects on river lamprey populations are not expected to be substantial under  
17 Alternative 1A. It is anticipated that there will not be an adverse effect on river lamprey and that  
18 there may be beneficial effects due to design, installation, and operation of new screens in the north  
19 Delta.

20 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
21 south SWP/CVP facilities are expected to substantially reduce entrainment of lamprey. However,  
22 operational activities associated with water exports from SWP/CVP north Delta intake facilities  
23 could result in an increase in entrainment or a loss of individual lamprey at that location. Monitoring  
24 and adaptive management protocols will be implemented to confirm that fish are being excluded  
25 from entrainment and impingement in the manner that the design specifications suggest. Overall,  
26 impacts of Alternative 1A water operations on entrainment of river lamprey are considered less  
27 than significant because they would not reduce their numbers. Consequently, no mitigation would  
28 be required.

### 29 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 30 **River Lamprey**

31 In general, Alternative 1A would not affect the quantity and quality of river lamprey spawning and  
32 egg incubation habitat relative to NAA.

33 Flow-related impacts to river lamprey spawning habitat were evaluated by estimating effects of flow  
34 alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames  
35 for river lamprey incorporated into the analysis. Lower flows can reduce the instream area available  
36 for spawning and rapid reductions in flow can dewater redds leading to mortality. The same  
37 locations were analyzed as for Pacific lamprey: the Sacramento River at Keswick and Red Bluff,  
38 Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, and American River at  
39 Nimbus Dam and at the confluence with the Sacramento River. River lamprey spawn in these rivers  
40 between February and June so flow reductions during those months have the potential to dewater  
41 redds, which could result in incomplete development of the eggs to ammocoetes (the larval stage).

1 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-  
 2 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning  
 3 location suitability characteristics (e.g., depth, velocity, substrate) of river lamprey are not  
 4 adequately described to employ a more formal analysis such as a weighted usable area analysis.  
 5 Therefore, as described for Pacific lamprey, there is uncertainty that these values represent actual  
 6 redd dewatering events, and results should be treated as rough estimates of flow fluctuations under  
 7 each model scenario. Results were expressed as the number of cohorts exposed to dewatering risk  
 8 and as a percentage of the total number of cohorts anticipated in the river based on the applicable  
 9 time-frame, February to June.

10 Flows in all rivers evaluated indicated increases in redd cohorts exposed would only occur in the  
 11 Feather River (17% increase) (Table 11-1A-80). All other locations would experience negligible  
 12 changes ( $\pm 5\%$ ) or reductions in redd cohort exposure under A1A\_LLT relative to NAA.

13 **Table 11-1A-80. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**  
 14 **Cohorts<sup>a</sup>**

Location	Comparison <sup>b</sup>	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River at Keswick	Difference	3	-2
	Percent Difference	9%	-6%
Sacramento River at Red Bluff	Difference	4	-5
	Percent Difference	11%	-13%
Trinity River downstream of Lewiston	Difference	-1	-1
	Percent Difference	-1%	-1%
Feather River Below Thermalito Afterbay	Difference	7	10
	Percent Difference	10%	17%
American River at Nimbus	Difference	4	1
	Percent Difference	7%	2%
American River at Sacramento River confluence	Difference	9	-2
	Percent Difference	15%	-3%

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

<sup>b</sup> Positive values indicate a higher value in Alternative 1A than in existing biological conditions.

15  
 16 River lamprey generally spawn between February and June (Beamish 1980, Moyle 2002). Using  
 17 Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water  
 18 temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same  
 19 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...  
 20 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for  
 21 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,  
 22 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both  
 23 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.  
 24 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM  
 25 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from  
 26 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods  
 27 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data

1 from the Bureau's temperature model. Each individual day or month starts a new "egg cohort" such  
2 that there are 12,320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid  
3 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using  
4 monthly data over the same period. The incubation periods used in this analysis are conservative  
5 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of  
6 the monthly average time step is limited because the extreme temperatures are masked; however,  
7 no better analytical tools are currently available for this analysis. Spawning locations of river  
8 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is  
9 thought to spawn in each river.

10 For both thresholds, there would be few differences in egg cohort exposure between NAA and  
11 Alternative 1A among all sites (Table 11-1A-81). Differences of 25 to 39 cohorts in the Sacramento  
12 River at Hamilton City are negligible to the population considering the total number of cohorts is  
13 12,320. In the Feather River below Thermalito Afterbay, there would be 23 more cohorts (61%  
14 increase) exposed to the 71.6°F threshold under Alternative 1A relative to NAA, although differences  
15 at the 77°F threshold would be negligible. In addition, there would be no differences between NAA  
16 and Alternative 1A in egg exposure at the Fish Barrier Dam in the Feather River. Overall, except at  
17 one location in the Feather River for the more conservative threshold temperature (71.6°F), these  
18 results indicate that there would be no differences in egg exposure to elevated temperatures under  
19 Alternative 1A.

1 **Table 11-1A-81. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg**  
2 **Cohort Temperature Exposure<sup>a</sup>**

Location	EXISTING CONDITIONS	
	vs. A1A_LL1	NAA vs. A1A_LL1
<b>71.6°F Threshold</b>		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	94 (NA)	-39 (-12%)
Trinity River at Lewiston	0 (NA)	0 (0%)
Trinity River at North Fork	2 (NA)	-2 (-40%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	33 (367%)	23 (61%)
American River at Nimbus	11 (220%)	-1 (-3%)
American River at Sacramento River Confluence	16 (57%)	-12 (-15%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	11 (1,100%)	0 (0%)
<b>77°F Threshold</b>		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	0 (NA)	25 (69%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	2 (NA)	2 (100%)
American River at Nimbus	1 (NA)	1 (25%)
American River at Sacramento River Confluence	4 (NA)	3 (50%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F and 77°F F during February to June on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

3  
4 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does  
5 not have the potential to substantially reduce spawning and egg incubation habitat. An increased  
6 risk of exposure by river lamprey eggs to redd dewatering and elevated temperatures under  
7 Alternative 1A would be limited to the Feather River below Thermalito Afterbay. There would be  
8 negligible or beneficial effects of Alternative 1A on redd dewatering risk and exposure to elevated  
9 water temperatures in all other locations examined.

10 **CEQA Conclusion:** In general, Alternative 1A would not affect the quantity and quality of river  
11 lamprey spawning and egg incubation habitat relative to the Existing Conditions.

12 Lower flows can reduce the instream area available for spawning and rapid reductions in flow can  
13 dewater redds leading to mortality. Effects of Alternative 1A on flow reductions during the river  
14 lamprey spawning period from February to June in the Sacramento, Feather, and American Rivers

1 consist of small increases in river lamprey redd cohort dewatering risk relative to Existing  
2 Conditions (Table 11-1A-80). Changes would be greatest in the American River (7% to 15%  
3 increase).

4 In the Sacramento River at Hamilton City, there would be 94 more cohorts (could not calculate  
5 relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 1A  
6 relative to Existing Conditions, although this represents a very small proportion of the total number  
7 of cohorts evaluated (12,320 cohorts) (Table 11-1A-81). Therefore, this slight increase in cohort  
8 exposure would not be biologically meaningful on a population level. There would be no differences  
9 between Existing Conditions and Alternative 1A at either location in the Trinity River. In the Feather  
10 River below Thermalito Afterbay, there would be 33 more cohorts (367% higher) exposed to the  
11 71.6°F threshold under Alternative 1A relative to Existing Conditions, although there would be no  
12 difference at the Fish Barrier Dam. At both locations in the American River, there would be 11 to 16  
13 more cohorts (57% to 220% higher) exposed to the 71.6°F threshold under Alternative 1A relative  
14 to Existing Conditions. In the Stanislaus River at Riverbank, there would be 11 more cohorts  
15 (1100% higher) exposed to the 71.6°F threshold under Alternative 1A relative to Existing  
16 Conditions, although there would be no difference at the Knights Ferry. There would be no  
17 differences between Existing Conditions and Alternative 1A at any location examined in exposure of  
18 egg cohorts to the 77°F threshold.

#### 19 **Summary of CEQA Conclusion**

20 The results of the Impact AQUA-184 CEQA analysis indicate that that the difference between the  
21 CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
22 alternative could substantially reduce the quality and quantity of spawning and egg incubation  
23 habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA  
24 conclusion set forth above. Alternative 1A would reduce river lamprey survival due to increased  
25 exposure to redd dewatering and increased water temperatures in multiple rivers relative to the  
26 Existing Conditions. Increased water temperatures would increase stress and reduce survival of  
27 lamprey eggs.

28 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
29 change, future water demands, and implementation of the alternative. The analysis described above  
30 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
31 the alternative from those of sea level rise, climate change and future water demands using the  
32 model simulation results presented in this chapter. However, the increment of change attributable  
33 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
34 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
35 implementation period, which does include future sea level rise, climate change, and water  
36 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
37 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
38 effect of the alternative from those of sea level rise, climate change, and water demands.

39 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
40 term implementation period and Alternative 1A indicates that flows and reservoir storage in the  
41 locations and during the months analyzed above would generally be similar between Existing  
42 Conditions during the LLT and Alternative 1A. This indicates that the differences between Existing  
43 Conditions and Alternative 1A found above would generally be due to climate change, sea level rise,  
44 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative

1 1A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
2 therefore would not in itself result in a significant impact on spawning and egg incubation habitat  
3 for river lamprey. This impact is found to be less than significant and no mitigation is required.

4 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

5 In general, Alternative 1A would reduce the quantity and quality of river lamprey rearing habitat  
6 relative to NAA. Flow-related effects on river lamprey rearing habitat were evaluated by estimating  
7 effects of flow alterations on ammocoete exposure, or stranding risk, as described for Pacific  
8 lamprey. Lower flows can reduce the instream area available for rearing and rapid reductions in  
9 flow can strand ammocoetes leading to mortality. Effects of Alternative 1A on flow were evaluated  
10 in the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, and the American  
11 River at Nimbus Dam and at the confluence with the Sacramento River. As for Pacific lamprey, the  
12 analysis of river lamprey ammocoete stranding was conducted by analyzing a range of month-over-  
13 month flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A  
14 cohort of ammocoetes was assumed to be born every month during their spawning period  
15 (February through June) and spend 5 years rearing upstream. Therefore, a cohort was considered  
16 stranded if at least one month-over-month flow reduction was greater than the flow reduction at  
17 any time during the period.

18 Ammocoete stranding risk under A1A\_LLT relative to NAA for the Sacramento River at Keswick  
19 (Table 11-1A-82) would be mostly negligible, except in the 65% flow reduction (12% higher risk).

20 Ammocoete stranding risk under A1A\_LLT in the Sacramento River at Red Bluff would be similar to  
21 or lower relative to NAA except in the 60% flow reduction (5% higher risk) (Table 11-1A-83).

22 **Table 11-1A-82. Percent Difference between Model Scenarios in the Number of River Lamprey**  
23 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**  
24 **Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	2	2
-65%	1	12
-70%	6	0
-75%	2	0
-80%	19	4
-85%	15	0
-90%	NA	0

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

25

1 **Table 11-1A-83. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 3 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	2
-60%	6	5
-65%	2	-4
-70%	15	0
-75%	5	-10
-80%	-6	-4
-85%	-9	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

4  
 5 In the Trinity River, there would be no difference in ammocoete stranding risk between NAA and  
 6 A1A\_LLT (Table 11-1A-84).

7 **Table 11-1A-84. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 8 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	-5
-80%	0	-2
-85%	0	-2
-90%	1	4

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

9  
 10 In the Feather River at Thermalito Afterbay, there would be no difference in ammocoete stranding  
 11 risk (Table 11-1A-85).

1 **Table 11-1A-85. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
 3 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	3
-85%	0	-19
-90%	0	-32

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

4  
 5 There would be no difference in ammocoete stranding risk except in the 90% flow reduction (7%  
 6 increase in stranding risk) at the confluence with the Sacramento River (Table 11-1A-86, Table 11-  
 7 1A-87) Based on the general decrease in frequency of most of the flow reduction categories, the  
 8 small increase (7%) predicted for a single flow reduction category (9%) at one location would not  
 9 have biologically meaningful effects.

10 **Table 11-1A-86. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 11 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
 12 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	-4
-70%	6	-9
-75%	3	-5
-80%	22	-11
-85%	11	-9
-90%	408	7

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

13

1 **Table 11-1A-87. Relative Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A1A_LLT	NAA vs. A1A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	-1
-70%	4	-6
-75%	2	2
-80%	18	4
-85%	7	-6
-90%	196	-9

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 1A.

4

5 Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of  
 6 Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et  
 7 al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be  
 8 conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day  
 9 or month starts a new “cohort” such that there are 18,730 cohorts for the Sacramento River,  
 10 corresponding to 82 years of ammocoetes being “born” every day each year from January 1 through  
 11 August 31, and 380 cohorts for the other rivers using monthly data over the same period.

12 In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative  
 13 1A would be similar to or lower than those under NAA (Table 11-A1-88). Biologically meaningful  
 14 exceptions includes the Trinity River at Lewiston and Feather River below Thermalito Afterbay for  
 15 the 71.6°F threshold and the Sacramento River at Hamilton City, Feather River below Thermalito  
 16 Afterbay, and American River at the Sacramento River confluence for the 77°F threshold.

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2  
3

**Table 11-1A-88. Differences (Percent Differences) between Model Scenarios in River Lamprey Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F and 77°F in at Least One Month**

Location	EXISTING CONDITIONS	
	vs. A1A_LL1	NAA vs. A1A_LL1
<b>71.6°F Threshold</b>		
Sacramento River at Keswick <sup>b</sup>	0 (NA)	1 (0.1%)
Sacramento River at Hamilton City <sup>b</sup>	4,326 (NA)	-715 (-8%)
Trinity River at Lewiston	25 (NA)	15 (30%)
Trinity River at North Fork	50 (NA)	-30 (-19%)
Feather River at Fish Barrier Dam	0 (NA)	-25 (-100%)
Feather River below Thermalito Afterbay	165 (87%)	60 (19%)
American River at Nimbus	175 (194%)	-15 (-4%)
American River at Sacramento River Confluence	120 (49%)	0 (0%)
Stanislaus River at Knights Ferry	0 (NA)	0 (0%)
Stanislaus River at Riverbank	155 (620%)	0 (0%)
<b>77°F Threshold</b>		
Sacramento River at Keswick <sup>b</sup>	0 (NA)	0 (NA)
Sacramento River at Hamilton City <sup>b</sup>	0 (NA)	1,948 (79%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	50 (NA)	60 (150%)
American River at Nimbus	90 (NA)	-25 (-11%)
American River at Sacramento River Confluence	130 (NA)	45 (20%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Positive values indicate a higher value in the preliminary proposal than in EXISTING CONDITIONS or NAA.

<sup>b</sup> Based on daily data; all other locations use monthly data; 1922–2003.

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**NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the potential to substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality. Increases in water temperatures under Alternative 1A would have adverse effects on ammocoete rearing conditions in the Sacramento, Feather, and American Rivers. Increased water temperatures would increase stress and reduce survival of lamprey ammocoetes. Alternative 1A would generally not affect river lamprey ammocoete stranding, except in the American River, in which there would be a beneficial effect from substantial decreases in exposure to flow reductions. This effect is a result of the specific reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible mitigation available. While the implementation of the mitigation measures listed below

1 has the potential to reduce the severity of the impact, these would not necessarily reduce the impact  
2 to a not adverse level.

3 **CEQA Conclusion:** In general, Alternative 1A would reduce the quantity and quality of river lamprey  
4 rearing habitat relative to the Existing Conditions.

5 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can  
6 strand ammocoetes leading to mortality. Differences in stranding risk between Existing Conditions  
7 and A1A\_LLT in the Sacramento River at Keswick would be negligible under most flow reductions  
8 and 6% to 19% higher risk under 70%, 80% and 85% flow reductions (Table 11-1A-82). Stranding  
9 risk under A1A\_LLT at Red Bluff would be up to 15% greater than risk under Existing Conditions in  
10 60% 70% and 75% flow reductions, up to 9% lower in 80% and 90% flow reductions, and negligible  
11 in 50% and 55% flow reductions (Table 11-1A-83).

12 In the Trinity River and Feather River, there would be no difference in ammocoete stranding risk  
13 between Existing Conditions and A1A\_LLT (Table 11-1A-84, Table 11-1A-85). Comparisons for the  
14 American River at Nimbus Dam (Table 11-1A-86) and at the confluence with the Sacramento River  
15 (Table 11-1A-87) indicated increased stranding risk under flow reductions of 70% and 80% to 90%  
16 for Alternative 1A compared to Existing Conditions.

17 The number of ammocoete cohorts exposed to 71.6°F under Alternative 1A would be higher than  
18 those under Existing Conditions in most locations examined (Table 11-A1-88). The number of  
19 ammocoete cohorts exposed to 77°F under Alternative 1A would be similar at all locations except  
20 the Feather River below Thermalito Afterbay and at both locations in the American River.

### 21 **Summary of CEQA Conclusion**

22 Collectively, these results indicate that the impact would be significant because it has the potential  
23 to substantially reduce rearing habitat and substantially reduce the number of fish as a result of  
24 ammocoete mortality. There would be increased exposure to critical water temperatures in the  
25 Sacramento, Feather, American, and Stanislaus River and substantial increases in exposure to flow  
26 reductions that could lead to stranding in the American River. Increased stranding risk in these  
27 rivers would increase the risk of desiccation and reduce survival of ammocoete cohorts. Increased  
28 water temperatures would increase stress and reduce survival of lamprey ammocoetes. This impact  
29 is a result of the specific reservoir operations and resulting flows associated with this alternative.  
30 Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent  
31 necessary to reduce this impact to a less-than-significant level would fundamentally change the  
32 alternative, thereby making it a different alternative than that which has been modeled and  
33 analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
34 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
35 severity of impact though not necessarily to a less-than-significant level.

### 36 **Mitigation Measure AQUA-185a: Following Initial Operations of CM1, Conduct Additional** 37 **Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of** 38 **Mitigation to Reduce Impacts to Rearing Habitat**

39 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have  
40 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
41 best available scientific information at the time and may prove to have been over- or  
42 understated. Upon the commencement of operations of CM1 and continuing through the life of

1 the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine  
2 whether such effects would be as extensive as concluded at the time of preparation of this  
3 document and to determine any potentially feasible means of reducing the severity of such  
4 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
5 consistent with the operational framework for Alternative 1A.

6 The development and implementation of any mitigation actions shall be focused on those  
7 incremental effects attributable to implementation of Alternative 1A operations only.  
8 Development of mitigation actions for the incremental impact on rearing habitat attributable to  
9 climate change/sea level rise are not required because these changed conditions would occur  
10 with or without implementation of Alternative 1A.

11 **Mitigation Measure AQUA-185b: Conduct Additional Evaluation and Modeling of Impacts**  
12 **River Lamprey Rearing Habitat Following Initial Operations of CM1**

13 Following commencement of initial operations of CM1 and continuing through the life of the  
14 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
15 modified operations could reduce impacts to rearing habitat under Alternative 1A. The analysis  
16 required under this measure may be conducted as a part of the Adaptive Management and  
17 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

18 **Mitigation Measure AQUA-185c: Consult with USFWS and CDFW to Identify and**  
19 **Implement Potentially Feasible Means to Minimize Effects on River Lamprey Rearing**  
20 **Habitat Consistent with CM1**

21 In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey  
22 habitat, the BDCP proponents will consult with USFWS and the Department of Fish and Wildlife  
23 to identify and implement any feasible operational means to minimize effects on rearing habitat.  
24 Any such action will be developed in conjunction with the ongoing monitoring and evaluation of  
25 habitat conditions required by Mitigation Measure AQUA-185a.

26 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
27 operational framework of Alternative 1A without causing new significant adverse impacts on  
28 other covered species, such means shall be implemented. If sufficient operational flexibility to  
29 reduce effects on river lamprey habitat is not feasible under Alternative 1A operations,  
30 achieving further impact reduction pursuant to this mitigation measure would not be feasible  
31 under this alternative, and the impact on river lamprey would remain significant and  
32 unavoidable.

33 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

34 In general, Alternative 1A would have negligible effects on river lamprey migration conditions  
35 relative to NAA.

36 ***Macrophthalmia***

37 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once  
38 they reach the Delta. River lamprey migration generally occurs September through November  
39 (USFWS unpublished data). The effects of water operations on seasonal migration flows for river  
40 lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely  
41 migration pathways of river lamprey during the likely migration period (September through

1 November) were examined to predict how Alternative 1A may affect migration flows for  
2 outmigrating macrophthalmia.

3 Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with  
4 the Sacramento River, and the American River at the confluence with the Sacramento River.

5 *Sacramento River*

6 Comparisons for the Sacramento River at Red Bluff for September through November indicate  
7 variable effects of Alternative 1A depending on the month and the water year type. Alternative 1A  
8 indicates variable effects, with project-related increases (5% to 33%) in dry and critical years in  
9 September, and all water year types in October that would have beneficial effects on migration  
10 conditions, relative to NAA. In contrast, decreased flows of between 5% to 44% in wetter years in  
11 September, and between 9% and 30% in all water year types in November, would result in negative  
12 effects. Decreases in wetter years would be less detrimental because flows are higher; the increases  
13 in drier water years would be beneficial for outmigration. Decreases (to 30%) for all years in  
14 November would affect migration conditions during that month, which is the last month in the  
15 relatively short migration period.

16 *Feather River*

17 Comparisons for the Feather River at the confluence with the Sacramento River for September  
18 through November indicate decreases in flow during wetter years in September (69%, 57%, and  
19 33% for wet, above normal, below normal, respectively) and increases in flow during drier years  
20 (17% and 18% for dry and critical years, respectively). The increases in flow during dry and critical  
21 years for September would have a positive effect on migration when flow conditions are most  
22 critical. There would also be project-related increases in flow during October in all water years,  
23 ranging from 5% to 55% depending on water year type. Project-related effects during November  
24 would be slightly increased (up to 7%) in all water year types with the exception of a small decrease  
25 in mean monthly flow (7%) during above normal years that would not have biologically meaningful  
26 effects, and a negligible difference in below normal years. These results indicate Alternative 1A  
27 would have generally beneficial effects on migration in the Feather River, relative to NAA.

28 *American River*

29 Comparisons for the American River at the confluence with the Sacramento River for September  
30 through November indicate decreased flows during September in wetter water years (up to 50%)  
31 and negligible effects (<5%) in drier water years when flow effects would be more detrimental for  
32 migration. The comparisons also indicated increases in mean monthly flows during October for all  
33 water year types (13 to 42%) and generally negligible project-related changes during November,  
34 except for a decrease of 18% in above normal years. These results indicate Alternative 1A would not  
35 substantially affect migration conditions for river lamprey in the American River.

36 Overall, with some variation in results by location, month, and water year type, Alternative 1A  
37 would generally not have biologically meaningful effects on macrophthalmia migration conditions  
38 based on negligible effects (<5%), decreases in flow during wetter water year types that would not  
39 have biologically meaningful effects, and increases in flow during drier water years that would have  
40 a beneficial effect on migration.

1 **Adults**

2 Effects of Alternative 1A on flow during the adult migration period, September through November,  
3 would be the same as described for the macropthalmia migration period, September through  
4 November, above.

5 **NEPA Effects:** Collectively, these results indicate that effects would not be adverse because it would  
6 not substantially reduce the amount of suitable habitat or substantially interfere with the movement  
7 of fish. Flows under Alternative 1A would be lower in wetter years in the Sacramento River, would  
8 be greater in the Feather River, and would not change in the American River relative to NAA. Flow  
9 reductions in wetter years would be less detrimental than reductions in drier years. In fact, flows in  
10 drier years in the Sacramento River would improve under Alternative 1A.

11 **CEQA Conclusion:** In general, under Alternative 1A water operations, the quantity and quality of  
12 suitable migration habitat for river lamprey would not be affected relative to the CEQA baseline.

13 **Macropthalmia**

14 *Sacramento River*

15 Comparisons for the Sacramento River at Red Bluff for September through November indicate  
16 variable effects of Alternative 1A during September, with decreases (up to 24%) occurring in all  
17 water year types, except for above normal years (6% increase) and below normal years (<5%).  
18 Alternative 1A would have beneficial effects for October with increased flows of between 15% and  
19 36% during all water years. Alternative 1A would result in decreases in mean monthly flows  
20 compared to Existing Conditions for all water year types in November (10 to 21%), except for a  
21 negligible difference in wet years. Persistent small to moderate reductions in flow in drier water  
22 years for two of the three months in the migration period would affect migration conditions in the  
23 Sacramento River.

24 *Feather River*

25 Comparisons for the Feather River at the confluence with the Sacramento River for September  
26 through November indicate variable results by month and water year type, with decreases (10% to  
27 27%) in all but critical water years in September and, variable results with primarily increases in  
28 October (between 18 and 35%), except for negligible differences in wet and below normal years.  
29 Relatively small and variable flow effects would occur in November, with decreases in wet (13%)  
30 and below normal (11%) years, an increase (6%) in critical years, and negligible changes in above  
31 normal and dry years. Decreased mean monthly flows in September and November during wetter  
32 water years would be less detrimental because flows are higher; the increases in drier water years  
33 in all three migration months would be beneficial for outmigration.

34 *American River*

35 Comparisons for the American River at the confluence with the Sacramento River for September  
36 through November indicate reductions in flow for all water year types in September (44% to 58%)  
37 and November (19% to 38%), but flow increases in all water years during October (5% to 45%).  
38 The overall predominance of decreased flows for Alternative 1A compared to Existing Conditions  
39 would affect migration conditions, with substantial decreases for dry and critical years in September  
40 (44 and 52%, respectively) and November (38 and 19%, respectively).

1 Overall, these results indicate that Alternative 1A would cause decreases in mean monthly flow  
2 during substantial portions of the river lamprey macrophthalmia migration period in the Sacramento  
3 River (to -21%), Feather River (to -27%), and American River (to -58%), compared to Existing  
4 Conditions.

#### 5 **Adults**

6 Effects of Alternative 1A on flow during the adult migration period, September through November,  
7 would be the same as described for the macrophthalmia migration period, September through  
8 November, above.

#### 9 **Summary of CEQA Conclusion**

10 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between  
11 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
12 alternative could substantially reduce the amount of suitable habitat and substantially interfere with  
13 the movement of fish, contrary to the NEPA conclusion set forth above. Reductions in flows during  
14 substantial portions of the macrophthalmia and adult migration periods in the Sacramento and  
15 American Rivers would reduce migration ability of both life stages. For macrophthalmia, reduced  
16 migration ability would increase straying risk and delay initiation of the oceanic life stage. For  
17 adults, reduced flows would reduce the ability to sense olfactory cues if adults use such cues to  
18 return to natal spawning grounds.

19 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
20 change, future water demands, and implementation of the alternative. The analysis described above  
21 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
22 the alternative from those of sea level rise, climate change and future water demands using the  
23 model simulation results presented in this chapter. However, the increment of change attributable  
24 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
25 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
26 implementation period, which does include future sea level rise, climate change, and water  
27 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
28 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
29 effect of the alternative from those of sea level rise, climate change, and water demands.

30 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
31 term implementation period and Alternative 1A indicates that flows and reservoir storage in the  
32 locations and during the months analyzed above would generally be similar between Existing  
33 Conditions during the LLT and Alternative 1A. This indicates that the differences between Existing  
34 Conditions and Alternative 1A found above would generally be due to climate change, sea level rise,  
35 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
36 1A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
37 therefore would not in itself result in a significant impact on migration conditions for river lamprey.  
38 This impact is found to be less than significant and no mitigation is required.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

3 ***Temporary Increases in Turbidity***

4 As with Pacific lamprey (see Impact AQUA-169), river lamprey are tolerant of turbid water  
5 conditions and are unlikely to be affected by temporary increases in turbidity during restoration  
6 construction. Implementing the environmental commitments described under Impact AQUA-1 for  
7 delta smelt and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater  
8 Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management  
9 Plan; Spill Prevention, Containment, and Countermeasure Plan; Fish Rescue and Salvage Plan; and  
10 Barge Operations Plan)*, would minimize the potential for turbidity to affect river lamprey.

11 ***Increased Exposure to Mercury***

12 The conversion of subtidal, unvegetated conditions to vegetated wetlands could enhance the cycling  
13 of mercury into biota by increasing the conversion of mercury to methylated mercury. The overall  
14 effect of increased bioavailability of methylmercury on lamprey is likely to be of low magnitude and  
15 localized (see discussion for delta smelt under Impact AQUA-7). With implementation of *CM12  
16 Methylmercury Management*, the potential effects of increased mobilization on lamprey at the  
17 restoration sites are expected to be minimized. However, the cycling of mercury is a complicated  
18 process, and is difficult to predict based on existing information.

19 ***Accidental Spills***

20 The potential risks of accidental spills (see the discussion for delta smelt under Impact AQUA-7)  
21 would be minimized by implementing the environmental commitments *Environmental Training;  
22 Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials  
23 Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils,  
24 Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan*; see Appendix 3B,  
25 *Environmental Commitments* and Impact AQUA-1). Specifically, the *Spill Prevention, Containment,  
26 and Countermeasure Plan* will be implemented to minimize the risk of spills occurring and to provide  
27 for rapid and effective response to contain any accidental spills.

28 ***Disturbance of Contaminated Sediments***

29 Runoff and resuspension of contaminants could cause short-term, localized increases in the  
30 concentrations of contaminants in and near restoration sites (see discussion for delta smelt under  
31 Impact AQUA-7). The potential impacts of toxics on lamprey would be minimized to the extent  
32 possible by timing construction activities so that vulnerable early life stages of fish are not present.  
33 Although lamprey ammocoetes would likely be present during the in-water work window,  
34 implementation of environmental commitments (see Appendix 3B) (*Environmental Training;  
35 Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Disposal of Spoils, Reusable  
36 Tunnel Material, and Dredged Material; and Barge Operations Plan*) would minimize exposure levels.  
37 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt. Because of the  
38 expected periodic and temporary nature of toxicity spikes and the timing of activities relative to  
39 species' presence, the potential effects would be minimized.

1 ***In-Water Work Activities***

2 Restoration construction activities could temporarily produce noise levels and disturbances that  
3 could affect nearby lamprey. Such activities are not expected to elevate underwater noise above the  
4 threshold sound pressure levels established for fish (see discussion for delta smelt under Impact  
5 AQUA-1). Any changes in disturbance levels would be minor and temporary, and unlikely to affect  
6 lamprey. Potential effects of in-water activity would be minimized by implementation of the  
7 environmental commitments described under Impact AQUA-1 and in Appendix 3B, *Environmental*  
8 *Commitments*, including *Erosion and Sediment Control Plan*; *Dispose of Spoils, Reusable Tunnel*  
9 *Material, and Dredged Material*; and *Barge Operations Plan*. Pertinent details of these plans are  
10 provided under Impact AQUA-1 for delta smelt.

11 ***Predation***

12 Although there is low certainty regarding their behavior in the Delta, lamprey macrothemia likely  
13 use the Delta primarily as a migration corridor, as evidenced by low catches in beach seines in back  
14 sloughs and higher catches in beach seines in mainstem sampling (U.S. Fish and Wildlife Service  
15 2013). Only a small proportion of the proposed habitat restoration would be located along major  
16 migration corridors, such as the mainstem Sacramento and San Joaquin rivers, in the West and  
17 South Delta ROAs. Therefore, it is presumed that lamprey will not spend large amounts of time in the  
18 vicinity of restored tidal marsh or floodplain habitat while they are being constructed. Additionally  
19 any in-water work may cause predatory fish to temporarily avoid those locations reducing the  
20 predation potential. Therefore, predation is not expected to increase, and the effect would not be  
21 adverse.

22 ***Summary***

23 In-water and shoreline construction activities associated with habitat restoration would be  
24 scheduled to occur when the least number of river lamprey are expected in or near the restoration  
25 sites. Such activities would include riprap removal and levee breaching, and shoreline excavation  
26 and re-contouring. River lamprey are tolerant to increases in turbidity, which might occur during  
27 shoreline restoration construction activities. Implementation of the environmental commitments  
28 described in Appendix 3B, *Environmental Commitments*, would minimize or eliminate effects on  
29 river lamprey (see Impact AQUA-181) by reducing the amount of turbidity and guiding the rapid  
30 and effective response in case of inadvertent spills of hazardous materials. These environmental  
31 commitments are *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and*  
32 *Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and*  
33 *Countermeasure Plan*; and *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*.  
34 Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt and Appendix 3B,  
35 *Environmental Commitments*. As a result, the effects of short-term restoration construction activities  
36 would not be adverse to river lamprey.

37 While implementation of these environmental commitments would minimize or eliminate short-  
38 term effects occurring during restoration construction, long-term effects could also occur. For  
39 example, removing or breaching levees would result in the expansion of floodplain habitat, and  
40 more frequent inundation these areas, potentially promoting conversion of mercury to methylated  
41 mercury, and runoff containing agricultural-related toxins such as copper and organochlorine  
42 pesticides. However, the overall effect of increased bioavailability of methylmercury and other  
43 pollutants on river lamprey is likely to be of low magnitude, periodic and localized. In addition,

1 potential increases would be minimized to the extent possible because of implementation of *CM12*  
2 *Methylmercury Management* (see Impact AQUA-181).

3 **NEPA Effects:** For the reasons described above, the effect would not adversely affect river lamprey  
4 populations.

5 **CEQA Conclusion:** In-water and shoreline construction activities associated with habitat restoration  
6 would be scheduled to occur when the least number of river lamprey would be expected to occur in  
7 or near the restoration sites. River lamprey are tolerant to increases in turbidity, which might occur  
8 during shoreline restoration construction activities, and implementation of the environmental  
9 commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
10 *Commitments* (see *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and*  
11 *Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and*  
12 *Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*), would  
13 minimize or eliminate the potential for turbidity, accidental spills, resuspension of contaminated  
14 sediments, or construction noise to affect river lamprey. Therefore, this impact is considered less  
15 than significant for river lamprey because it would not substantially reduce available habitat, or  
16 restrict the range or movement of river lamprey. Consequently, no mitigation would be required.

#### 17 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River** 18 **Lamprey**

19 A complete analysis can be found in the *BDCP Effects Analysis – Appendix D, Contaminants (hereby*  
20 *incorporated by reference)*. The effects of contaminants on river lamprey associated with project  
21 operations and habitat restoration are expected to be similar to that for Pacific lamprey (Impact  
22 AQUA-170).

23 **NEPA Effects:** Alternative 1A actions are likely to result in increased production, mobilization, and  
24 bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system. However,  
25 any such releases would be sporadic, short-term and localized, and would be unlikely to result in  
26 measurable increases in the bioaccumulation in river lamprey. Implementation of *CM12*  
27 *Methylmercury Management* would also help to minimize the increased mobilization of  
28 methylmercury at restoration areas. The effects of contaminants on river lamprey associated with  
29 restoration measures would not be adverse, while the overall effects of the restored habitat are  
30 expected to be beneficial.

31 **CEQA Conclusion:** Alternative 1A actions are likely to result in increased production, mobilization,  
32 and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system.  
33 However, any such releases would be sporadic, short-term and localized, and would be unlikely to  
34 result in measurable increases in the bioaccumulation in river lamprey. Implementation of *CM12*  
35 *Methylmercury Management* would also help to minimize the increased mobilization of  
36 methylmercury at restoration areas. Therefore, the impact of contaminants would be less than  
37 significant because it would not substantially affect river lamprey either directly or through habitat  
38 modifications and, with restoration, would be beneficial in the long-term. Consequently, no  
39 mitigation would be required

#### 40 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

41 Refer to Impact AQUA-171 under Pacific lamprey for a discussion of the effects or restored habitat  
42 conditions on river lamprey.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

3 Refer to Impact AQUA-172 under Pacific lamprey for a discussion of the effects of methylmercury  
4 management on river lamprey.

5 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
6 **(CM13)**

7 The following analysis is based on the more detailed analysis included in *BDCP Effects Analysis –*  
8 *Appendix F, Biological Stressors, Section F.1.1 Invasive Aquatic Vegetation, Section F.4 Invasive Aquatic*  
9 *Vegetation, and F.5.3.2.3 Nonnative Aquatic Vegetation Control (Conservation Measure 13) (hereby*  
10 *incorporated by reference).*

11 **NEPA Effects:** A general analysis of the effects on covered fish species has been conducted that was  
12 described above for delta smelt (see Impact AQUA-11). Potential impacts on river lamprey from IAV  
13 control during operations are similar to those discussed above for Pacific lamprey (see Impact  
14 AQUA-173). The control of IAV with implementation of *CM13 Invasive Aquatic Vegetation Control* is  
15 expected to maintain or improve turbidity conditions that could benefit river lamprey rearing  
16 conditions. The control of IAV would also increase the amount of rearing habitat, as well as access to  
17 the habitat and potential increases in food availability. Therefore, the effects of IAV control are  
18 expected to provide an overall benefit to river lamprey.

19 **CEQA Conclusion:** The control of IAV should provide a modest net benefit to river lamprey during  
20 operations through chemical and mechanical treatment and is considered a beneficial impact by  
21 reducing predation mortality, increasing food availability, and increasing rearing habitat. The impact  
22 is expected to be beneficial, consequently, no mitigation would be required.

23 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

24 Refer to Impact AQUA-174 under Pacific lamprey for a discussion of the effects of oxygen level  
25 management on river lamprey.

26 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

27 Refer to Impact AQUA-175 under Pacific lamprey for a discussion of the effects of predator  
28 management on river lamprey.

29 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

30 Refer to Impact AQUA-176 under Pacific lamprey for a discussion of the effects of nonphysical fish  
31 barriers on river lamprey.

32 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

33 Refer to Impact AQUA-177 under Pacific lamprey for a discussion of illegal harvest reduction on  
34 river lamprey.

1 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

2 Refer to Impact AQUA-178 under Pacific lamprey for a discussion of conservation hatcheries on  
3 river lamprey.

4 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

5 Refer to Impact AQUA-179 under Pacific lamprey for a discussion of urban stormwater treatment on  
6 river lamprey.

7 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey  
8 (CM21)**

9 Refer to Impact AQUA-180 under Pacific lamprey for a discussion of removal/relocation of  
10 nonproject diversions on river lamprey.

11 **Non-Covered Aquatic Species of Primary Management Concern**

12 The non-covered fish and aquatic species identified as special status by state or federal agencies, or  
13 that are of particular ecological, recreational, or commercial importance are listed below.

- 14 ● Striped bass
- 15 ● American shad
- 16 ● Threadfin shad
- 17 ● Largemouth bass
- 18 ● Sacramento tule perch
- 19 ● Sacramento-San Joaquin roach – California species of special concern
- 20 ● Hardhead – California species of special concern – California species of special concern
- 21 ● California bay shrimp

22 Striped bass, American shad, and largemouth bass are all sport fish species and were introduced  
23 into rivers for that purpose. All three species are regulated by CDFW for recreational fishing. Roach,  
24 hardhead, and Sacramento tule perch are native fish species that are important to the aquatic  
25 ecosystem. Threadfin shad are nonnative fish species that were introduced as forage fish for game  
26 fish. All of these fish species could be present during construction activities for intakes and barge  
27 landings, although it is unlikely that roach or hardhead would be affected as they reside primarily  
28 within tributary streams and their primary distributions are upstream of the action area. California  
29 bay shrimp occur in San Francisco and San Pablo bays, Suisun Bay and Suisun Marsh, and the  
30 western delta in low salinity waters.

31 **Construction and Maintenance of CM1**

32 The effects of construction and maintenance of CM1 under Alternative 1A would be similar for all  
33 non-covered species depending on abundance within the area; therefore, the analysis below is  
34 combined for all non-covered species instead of analyzed by individual species.

1 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**  
2 **Aquatic Species of Primary Management Concern**

3 **NEPA Effects:** Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of  
4 construction of water conveyance facilities on non-covered species of primary management  
5 concern. That discussion under delta smelt addresses the type, magnitude and range of impact  
6 mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects  
7 of the construction of water conveyance facilities would be similar to those described there.  
8 California bay shrimp would not be affected because they do not occur in the vicinity. Similarly, it is  
9 unlikely that roach or hardhead would be affected, as they reside primarily within tributary streams,  
10 upstream of the construction areas. Consequently, the effects would not be adverse.

11 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact  
12 of the construction of water conveyance facilities would not be significant on non-covered aquatic  
13 species of primary management concern except potentially for construction noise associated with  
14 pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b  
15 would reduce that noise impact to less than significant.

16 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
17 **of Pile Driving and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

19 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
20 **and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

22 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
23 **Aquatic Species of Primary Management Concern**

24 **NEPA Effects:** Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of  
25 maintenance of water conveyance facilities on non-covered species of primary management  
26 concern. That discussion under delta smelt addresses the type, magnitude and range of impact  
27 mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects  
28 of the construction of maintenance of water conveyance facilities would be similar to those  
29 described there. California bay shrimp would not be affected because they do not occur in the  
30 vicinity. Consequently, the effects would not be adverse. Similarly, it is unlikely that roach or  
31 hardhead would be affected as they occur primarily in tributary streams and upstream of the  
32 maintenance areas.

33 **CEQA Conclusion:** As described above, these impacts would be less than significant.

34 **Water Operations of CM1**

35 The effects of water operations of CM1 under Alternative 1A include analysis of the following  
36 species:

- 37 ● Striped Bass
- 38 ● American Shad
- 39 ● Threadfin Shad

- 1 • Largemouth Bass
- 2 • Sacramento Tule Perch
- 3 • Sacramento-San Joaquin roach – California species of special concern
- 4 • Hardhead – California species of special concern
- 5 • California bay shrimp

6 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
7 **Species of Primary Management Concern**

8 **NEPA Effects:** Refer to Impact AQUA-3 under delta smelt for a discussion of the effects of water  
9 operations on entrainment of non-covered species of primary management concern. That discussion  
10 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
11 to the aquatic environment and aquatic species. The potential effects of water operations would be  
12 similar to those described there, although there are some caveats for each species. Striped bass  
13 larvae could be entrained at the water diversion facilities in both the north and south Delta,  
14 although larval entrainment is not thought to have population consequences due to the large  
15 fecundity of individual females and the fact that population levels do not correspond to numbers of  
16 adults (Moyle 2002). Largemouth bass are nest builders and typically build their nests in quiet, low  
17 flow backwaters and are unlikely to be entrained at facilities. Both shad species are very similar in  
18 morphology at the larval stage to Delta smelt and entrainment would be similar. The difference lies  
19 in the larval and early juvenile distribution which would create more opportunities for interaction  
20 with diversion facilities, although it is not thought that entrainment is a limiting factor for any of  
21 these species. Tule perch is a live bearing surf perch usually found in heavy cover or rip-rap and are  
22 unlikely to be affected, as the population is widespread and is not easily entrained, and on average it  
23 makes up only a fraction of all species salvaged at the south Delta facilities. California bay shrimp do  
24 not occur in freshwater and would not be affected, and it is unlikely that hardhead or roach would  
25 be affected, because their distributions are almost exclusively in upstream areas. Consequently, the  
26 effects would not be adverse.

27 **CEQA Conclusion:** As described above, these impacts would be less than significant.

28 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
29 **Non-Covered Aquatic Species of Primary Management Concern**

30 **Striped Bass**

31 In general, Alternative 1A would slightly improve the quality and quantity of upstream habitat  
32 conditions for striped bass relative to the NAA.

33 **Flows**

34 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
35 Clear Creek were examined during the April through June striped bass spawning, embryo  
36 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
37 habitat available for spawning, egg incubation, and rearing, although striped bass distribution  
38 occurs below Red Bluff Diversion Dam which would exclude striped bass from the upper  
39 Sacramento and Clear Creek (Moyle 2002). Striped bass are also not known to occur in the Trinity  
40 River (Moyle 2002) Striped bass are broadcast spawners not needing substrate like salmon for egg

1 incubation. The eggs are slightly heavier than water but any amount of current will suspend the eggs  
2 off the bottom, thus the lowering of current will not affect viability of embryos.

3 Striped bass are not thought to occur above Red Bluff in the Sacramento River and are not known  
4 from the Trinity River or Clear Creek.

5 In the Feather River at Thermalito Afterbay, flows under A1A\_LLTP would generally be substantially  
6 greater (up to 219% greater) than flows under NAA during April through June (Appendix 11C,  
7 CALSIM II Model Results utilized in the Fish Analysis).

8 In the American River at Nimbus Dam, flows under A1A\_LLTP would always be greater than flows  
9 under NAA regardless of water year type (Appendix 11C, CALSIM II Model Results utilized in the  
10 Fish Analysis).

11 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
12 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
13 fall-/late-fall run ESU). The analysis for Alternative 1A indicates that there would be no differences  
14 in flows relative to the NAA.

### 15 ***Water Temperature***

16 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
17 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
18 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
19 range could lead to reduced spawning success and increased egg and larval stress and mortality.  
20 Striped bass are known to migrate upstream until temperatures reach 59°F and then spawn, thus in  
21 low temperature years they migrate upstream farther than when temperatures are warmer. It is  
22 unlikely that striped bass would spawn under less than minimal temperature needs for embryo  
23 development, thus temperature is not a likely stressor on striped bass embryo development. Water  
24 temperatures were not modeled in the San Joaquin River or Clear Creek.

25 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLTP outside  
26 the range would be lower than the percentage under NAA in all water years (Table 11-1A-89). The  
27 percentage of months under A1A\_LLTP outside the range would be similar to or lower than the  
28 percentage under NAA in below normal and critical water year types and slightly higher in all other  
29 types (up to 11% higher). Striped bass spawning distribution is known to occur below Red Bluff,  
30 (Moyle 2002).

31 In the Trinity River below Lewiston Reservoir, the percentage of months under A1A\_LLTP outside the  
32 range would be similar to or lower than the percentage under NAA in all water years except critical  
33 years compared to NAA (7% higher) (Table 11-1A-89). Striped bass are not known to occur in the  
34 Trinity River (Moyle 2002).

1 **Table 11-1A-89. Difference and Percent Difference in the Percentage of Months during April–June**  
 2 **in Which Water Temperatures Are outside the 59°F to 68°F Water Temperature Range for Striped**  
 3 **Bass Spawning, Embryo Incubation, and Initial Rearing<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	-13 (-14%)	9 (11%)
	Above Normal	-12 (-13%)	6 (7%)
	Below Normal	-19 (-20%)	2 (2%)
	Dry	-15 (-16%)	6 (7%)
	Critical	-23 (-27%)	-1 (-1%)
	All	-16 (-17%)	5 (7%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	-3 (-3%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	-2 (-2%)	0 (0%)
	Critical	-17 (-17%)	6 (7%)
	All	-3 (-3%)	1 (1%)
Feather River below Thermalito Afterbay	Wet	0 (0%)	-5 (-12%)
	Above Normal	-18 (-40%)	-15 (-56%)
	Below Normal	-12 (-28%)	-14 (-46%)
	Dry	-2 (-4%)	2 (4%)
	Critical	11 (29%)	-3 (-6%)
	All	-3 (-8%)	-6 (-15%)
American River below Nimbus Dam	Wet	-27 (-54%)	-8 (-33%)
	Above Normal	-15 (-45%)	-6 (-33%)
	Below Normal	-19 (-53%)	-5 (-29%)
	Dry	-2 (-7%)	-11 (-43%)
	Critical	14 (42%)	6 (12%)
	All	-12 (-33%)	-6 (-23%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	-3 (-3%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4  
 5 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
 6 the range would be lower than the percentage under NAA in all water years except critical years  
 7 (16% higher) (Table 11-1A-89). The percentage of months under A1A\_LLT outside the range would  
 8 be similar to or lower than the percentage under NAA in all water year types.

1 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
2 range would be lower than the percentage under NAA in all water years except critical years (12%  
3 higher compared to NAA) (Table 11-1A-89).

4 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
5 the range would be similar to or lower than the percentage under NAA in all water years (Table 11-  
6 1A-89).

7 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
8 Alternative 1A would not cause a substantial reduction in striped bass spawning, incubation, or  
9 initial rearing habitat. Flows in all rivers examined during the April through June spawning,  
10 incubation, and initial rearing period under Alternative 1A would generally be similar to or greater  
11 than flows under the NAA. Overall, there would be flow increases in all waterways except Trinity  
12 River and Clear Creek. The percentage of months outside the 59°F to 68°F water temperature range  
13 would generally be lower under Alternative 1A than under the NAA. The increased frequency in  
14 months outside the temperature range in the Sacramento River would not be of sufficient magnitude  
15 to have a population level effect on striped bass.

16 **CEQA Conclusion:** In general, Alternative 1A would slightly improve the quality and quantity of  
17 upstream habitat conditions for striped bass relative to Existing Conditions.

#### 18 **Flows**

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
20 Clear Creek were examined during the April through June striped bass spawning, embryo  
21 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
22 habitat available for spawning, egg incubation, and rearing.

23 Striped bass are not thought to occur above Red Bluff in the Sacramento River and are not known to  
24 occur in the Trinity River or Clear Creek.

25 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be similar to or  
26 greater than flows under Existing Conditions during April through June, except in wet years during  
27 May (28% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

28 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
29 greater than flows under Existing Conditions during April and June, except in above normal years  
30 during April (6% lower) and wet and critical years during June (24% and 31% lower, respectively),  
31 but generally lower, by up to 24%, during May (Appendix 11C, CALSIM II Model Results utilized in  
32 the Fish Analysis).

33 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
34 covered fish species under Alternative 1A (see AQUA-76, -77, and -78 under Chinook salmon fall-  
35 /late-fall run ESU). The analysis indicates that there would be small to moderate reductions in flows  
36 during the period relative to Existing Conditions.

#### 37 **Water Temperature**

38 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
39 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
40 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
41 range could lead to reduced spawning success and increased egg and larval stress and mortality.

1 Striped bass are known to migrate upstream until temperatures reach 59°F and then spawn, thus in  
2 low temperature years they migrate upstream farther than when temperatures are warmer. It is  
3 unlikely that striped bass would spawn under less than minimal temperature needs for embryo  
4 development, thus temperature is not a likely stressor on striped bass embryo development. Water  
5 temperatures were not modeled in the San Joaquin River or Clear Creek.

6 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
7 the range would be lower than the percentage under Existing Conditions in all water years except  
8 critical years (29% higher) (Table 11-1A-89).

9 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
10 range would be lower than the percentage under Existing Conditions in all water years except  
11 critical years (42% higher) (Table 11-1A-89).

12 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
13 the range would be similar to or lower than the percentage under Existing Conditions in all water  
14 years (Table 11-1A-89).

15 Collectively, these results indicate that the impact would not be significant because Alternative 1A  
16 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of  
17 striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and  
18 Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under  
19 Alternative 1A would generally be similar to or greater than flows under Existing Conditions. Flows  
20 in the San Joaquin and Stanislaus rivers would be lower under Alternative 1A, although this effect  
21 would not be biologically meaningful to striped bass. The percentage of months outside the 59°F to  
22 68°F water temperature range would generally be lower under Alternative 1A than under CEQA  
23 baseline, particularly in the American River (up to 54% reduction in percentage of months).

#### 24 **American Shad**

25 In general, Alternative 1A would slightly improve the quality and quantity of upstream habitat  
26 conditions for American shad relative to the NAA.

#### 27 **Flows**

28 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
29 Clear Creek were examined during the April through June American shad adult migration and  
30 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
31 quality for spawning. It is unlikely that the lesser amount of flow will impact the migration ability of  
32 American shad. Given their much smaller body size and their known use of much smaller streams  
33 (e.g., Cosumnes River), plus their use of broadcast spawning it is unlikely that lowered flow would  
34 have a negative effect on them in this way.

35 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
36 or greater than flows under NAA during April through June (Appendix 11C, CALSIM II Model Results  
37 utilized in the Fish Analysis). Although American shad juveniles do appear in screw trap data at Red  
38 Bluff the numbers are very small. For example, four American shad were caught in 2000 out of over  
39 889,000 fish caught (Gaines and Martin 2001).

40 In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
41 or greater than flows under NAA during April through June except in above normal years during

1 April compared (11% lower)(Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
2 Although American shad juveniles do appear in screw trap data at Willow Creek the numbers are  
3 very small. For example one American shad was caught by screw trap at Willow Creek in 2007  
4 (Pinnix et al. 2010).

5 American shad are not known from Clear Creek.

6 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be substantially  
7 greater (up to 219% greater) than flows under NAA during April through June (Appendix 11C,  
8 CALSIM II Model Results utilized in the Fish Analysis).

9 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be greater than flows  
10 under NAA regardless of water year type (Appendix 11C, CALSIM II Model Results utilized in the  
11 Fish Analysis).

12 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
13 covered fish species under Alternative 1A (see AQUA-76, -77, and -78 under Chinook salmon fall-  
14 /late-fall run ESU). That analysis indicates that there would be no differences in flows relative to the  
15 NAA.

#### 16 **Water Temperature**

17 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
18 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
19 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
20 reduced spawning success and increased adult migrant stress and mortality. The range of 60°F to  
21 70°F is the spawning range in general of American shad in the Sacramento River. The spawning  
22 temperature range does not imply that temperatures below this would be stressful to migrating  
23 shad. Male shad migrate to spawning areas much earlier than females with much lower  
24 temperatures with no apparent migration stress or mortality. Water temperatures were not  
25 modeled in the San Joaquin River or Clear Creek.

26 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
27 the range would be similar to or lower than the percentage under NAA in most water year types and  
28 slightly higher in wet and dry water year types (7% and 5% higher, respectively). Although  
29 American shad juveniles do appear in screw trap data at Red Bluff the numbers are very small. For  
30 example, four American shad were caught in 2000 out of over 889,000 fish caught (Gaines and  
31 Martin 2001).

32 In the Trinity River below Lewiston Reservoir, the percentage of months under A1A\_LLT outside the  
33 range would be similar to or lower than the percentage under NAA in all water years (Table 11-1A-  
34 90). In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT  
35 outside the range would be similar to or lower than the percentage under NAA in all water year  
36 types (Table 11-1A-90).

37 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
38 60°F to 70°F water temperature range would be similar to or lower than the percentage under NAA  
39 in all water year types (Table 11-1A-90).

40 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
41 the range would be similar to the percentage under NAA in all water year types (Table 11-1A-90).

1 **Table 11-1A-90. Difference and Percent Difference in the Percentage of Months during April–June**  
 2 **in Which Water Temperatures Are outside the 60°F to 70°F Water Temperature Range for**  
 3 **American Shad Adult Migration and Spawning<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	-9 (-9%)	6 (7%)
	Above Normal	-8 (-8%)	4 (4%)
	Below Normal	-15 (-15%)	-1 (-1%)
	Dry	-8 (-8%)	4 (5%)
	Critical	-18 (-20%)	0 (0%)
	All	-11 (-11%)	3 (4%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	-3 (-3%)	0 (0%)
	Below Normal	-2 (-2%)	0 (0%)
	Dry	-2 (-2%)	0 (0%)
	Critical	-11 (-11%)	0 (0%)
	All	-3 (-3%)	0 (0%)
Feather River below Thermalito Afterbay	Wet	-5 (-11%)	0 (0%)
	Above Normal	-3 (-8%)	-12 (-36%)
	Below Normal	0 (0%)	-7 (-23%)
	Dry	-2 (-5%)	-7 (-20%)
	Critical	3 (8%)	-3 (-7%)
	All	-2 (-5%)	-5 (-13%)
American River below Nimbus Dam	Wet	-32 (-56%)	0 (0%)
	Above Normal	-24 (-57%)	-6 (-33%)
	Below Normal	-21 (-50%)	-5 (-22%)
	Dry	-6 (-21%)	-4 (-18%)
	Critical	14 (63%)	-6 (-15%)
	All	-16 (-40%)	-3 (-14%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	0 (0%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 6 Alternative 1A would not cause a substantial reduction in American shad spawning or adult  
 7 migration. Flows in all rivers examined during the April through June adult migration and spawning  
 8 period under Alternative 1A would generally be similar to or greater than flows under NAA. Overall,  
 9 there would be flow increases in all waterways except Trinity River and Clear Creek. The percentage  
 10 of months outside the 60°F to 70°F water temperature range would generally be lower under  
 11 Alternative 1A than under NAA in all waterways examined.

1 **CEQA Conclusion:** In general, Alternative 1A would slightly improve the quality and quantity of  
2 upstream habitat conditions for American shad relative to Existing Conditions.

### 3 **Flows**

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
5 Clear Creek were examined during the April through June American shad adult migration and  
6 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
7 quality for spawning. It is unlikely that the lesser amount of flow will impact the migration ability of  
8 American shad. Given their much smaller body size and their known use of much smaller streams  
9 (e.g., Cosumnes River), plus their use of broadcast spawning it is unlikely that lowered flow would  
10 affect them in this way.

11 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
12 or greater than flows under Existing Conditions during April through June, except in wet years  
13 during May (14% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
14 Although American shad juveniles do appear in screw trap data at Red Bluff the numbers are very  
15 small. For example, four American shad were caught in 2000 out of over 889,000 fish caught (Gaines  
16 and Martin 2001).

17 In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
18 or greater than flows under Existing Conditions during April through June, except in critical years  
19 during May (6% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
20 Although American shad juveniles do appear in screw trap data at Willow Creek the numbers are  
21 very small. For example, one American shad was caught by screw trap at Willow Creek in 2007  
22 (Pinnix et al. 2010).

23 American shad are not known from Clear Creek.

24 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
25 greater than flows under Existing Conditions during April and June, except in above normal years  
26 during April (6% lower) and wet and critical years during June (24% and 31% lower, respectively),  
27 but generally lower, by up to 24%, during May (Appendix 11C, CALSIM II Model Results utilized in  
28 the Fish Analysis).

29 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
30 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
31 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
32 flows during the period relative to Existing Conditions.

### 33 **Water Temperature**

34 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
35 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
36 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
37 reduced spawning success and increased adult migrant stress and mortality. The range of 60°F to  
38 70°F is the spawning range in general of American shad in the Sacramento River. The spawning  
39 temperature range does not imply that temperatures below this would be stressful to migrating  
40 shad. Male shad migrate to spawning areas much earlier than females with much lower  
41 temperatures with no apparent migration stress or mortality. Water temperatures were not  
42 modeled in the San Joaquin River or Clear Creek.

1 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
2 the range would be lower than the percentage under Existing Conditions in all water years (Table  
3 11-1A-90). Although American shad juveniles do appear in screw trap data at Red Bluff the numbers  
4 are very small. For example, four American shad were caught in 2000 out of over 889,000 fish  
5 caught (Gaines and Martin 2001).

6 In the Trinity River below Lewiston Reservoir, the percentage of months under A1A\_LLT outside the  
7 range would be similar to or lower than the percentage under Existing Conditions in all water year  
8 types (Table 11-1A-90). Although American shad juveniles do appear in screw trap data at Willow  
9 Creek the numbers are very small. For example, one American shad was caught by screw trap at  
10 Willow Creek in 2007 (Pinnix et al. 2010).

11 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
12 the range would be similar to or lower than the percentage under Existing Conditions in all water  
13 years except critical years (8% higher) (Table 11-1A-90).

14 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside of the  
15 60°F to 70°F water temperature range would be similar to or lower than the percentage under  
16 Existing Conditions in all water years except critical years (63% higher) (Table 11-1A-90).

17 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
18 the range would be similar to the percentage under Existing Conditions in all water year types  
19 (Table 11-1A-90).

20 Collectively, these results indicate that the impact would not be significant because Alternative 1A  
21 would not cause a substantial reduction in American shad adult migration or spawning habitat, and  
22 no mitigation is necessary. Flows in all rivers examined, except the San Joaquin and Stanislaus rivers  
23 during the April through June adult migration and spawning period under Alternative 1A, would  
24 generally be similar to or greater than flows under Existing Conditions. Flows in the San Joaquin and  
25 Stanislaus rivers would be lower under Alternative 1A, although this effect would not be biologically  
26 meaningful to American shad. The percentage of months outside the 60°F to 70°F water  
27 temperature range would generally be similar to or lower under Alternative 1A than under the  
28 CEQA baseline, particularly in the Sacramento and American rivers (up to 57% reduction) (Table  
29 11-1A-90).

### 30 **Threadfin Shad**

31 In general, Alternative 1A would not affect the quality and quantity of upstream habitat conditions  
32 for threadfin shad relative to the NAA. The primary distribution of threadfin shad is within the Delta  
33 and lower rivers and in reservoirs. Threadfin shad that are seen in tributaries and the mainstem  
34 Sacramento River are produced in reservoirs and transported downstream during high flows.  
35 Threadfin shad are not migrating upstream to spawn in these areas, and may persist in these  
36 downstream areas during times of low flow. It is likely that there is a pattern of reintroduction that  
37 allows threadfin shad to persist in these upstream areas. Threadfin shad use floating objects such as  
38 vegetation and wood to spawn on so it is unlikely that their spawning habitat would be reduced  
39 (Moyle 2002).

1       **Flows**

2       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3       Clear Creek were examined during April through August threadfin shad spawning period. Lower  
4       flows could reduce the quantity and quality of instream habitat (backwaters) available for spawning.  
5       Threadfin shad are just transient in these upstream areas as they are being flushed out of reservoirs  
6       downstream.

7       In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
8       or greater than flows under NAA during April through July except in below normal and dry years  
9       during July (8% lower for both), and up to 19% lower during August (Appendix 11C, CALSIM II  
10       Model Results utilized in the Fish Analysis). Although the numbers are small as indicated by screw  
11       trap catches at Red Bluff Diversion Dam where 1,260 threadfin shad were caught out of a total of  
12       857,727 total fish caught (Gaines and Martin 2001).

13       Threadfin shad are not known from the Trinity River system (Pinnix et al. 2010).

14       In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
15       than flows under NAA throughout the period, except in critical years during June (8% lower)  
16       (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Threadfin shad are not  
17       known from Clear Creek screw trap data (Gaines and Martin 2001; Greenwald et al. 2003; Earley et  
18       al. 2008a, 2008b, 2009, 2010).

19       In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally greater during  
20       April through June (up to 219% greater) and generally be lower than those under NAA during July  
21       and August (up to 51% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish  
22       Analysis).

23       In the American River at Nimbus Dam, flows under A1A\_LLT would generally lower than flows  
24       under NAA during July and August (up to 30% lower), greater during May and June (up to 31%  
25       greater), and similar between NAA and A1A\_LLT during April.

26       Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
27       covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
28       fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
29       the NAA.

30       **Water Temperature**

31       The percentage of months below 68°F water temperature threshold for the April through August  
32       adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
33       and Stanislaus rivers. Water temperatures below this threshold could delay spawning in these areas.  
34       According to Moyle (2002) the peak of spawning occurs at a temperature of 68°F, although  
35       spawning has been observed to occur from 57°F to 64°F. This makes it likely that threadfin shad can  
36       spawn successfully at much lower temperatures than 68°F, although their survival is higher at  
37       hatching  $\geq 8$  at above 66°F (Betsill and Avyle 1997). Water temperatures were not modeled in the  
38       San Joaquin River or Clear Creek.

1 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
2 the range would be similar to or lower than the percentage under NAA in all water year types (Table  
3 11-1A-91). Although numbers are small as indicated by screw trap catches at Red Bluff Diversion  
4 Dam where 1,260 threadfin shad were caught out of a total of 857,727 total fish caught (Gaines and  
5 Martin 2001).

6 Threadfin shad are not known from the Trinity River system (Pinnix et al. 2010).

7 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
8 the range would be higher than the percentage under NAA in wet, above, and below normal water  
9 years (up to 9% higher) (Table 11-1A-91).

10 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT below the 68°F  
11 water temperature threshold would be similar to or lower than the percentage under NAA in all  
12 water year types (Table 11-1A-91).

13 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT below  
14 the 68°F water temperature threshold would be similar to or lower than the percentage under NAA  
15 in all water year types (Table 11-1A-91).

1 **Table 11-1A-91. Difference and Percent Difference in the Percentage of Months in Which April–**  
 2 **August Water Temperatures Fall below the 68°F Water Temperature Threshold for Threadfin Shad**  
 3 **Spawning<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	-16 (-16%)	0 (0%)
	All	-2 (-2%)	0 (0%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	-13 (-13%)	0 (0%)
	All	-2 (-2%)	0 (0%)
Feather River below Thermalito Afterbay	Wet	-10 (-16%)	3 (6%)
	Above Normal	-25 (-33%)	4 (7%)
	Below Normal	-20 (-29%)	4 (9%)
	Dry	-34 (-46%)	-4 (-11%)
	Critical	-30 (-46%)	-2 (-5%)
	All	-22 (-32%)	1 (2%)
American River below Nimbus Dam	Wet	-28 (-29%)	0 (0%)
	Above Normal	-22 (-23%)	0 (0%)
	Below Normal	-23 (-25%)	-7 (-10%)
	Dry	-38 (-43%)	0 (0%)
	Critical	-23 (-41%)	-2 (-5%)
	All	-28 (-32%)	-1.5 (-2%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	-2 (-2%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 6 Alternative 1A would not cause a substantial reduction in spawning habitat. Flows in all rivers  
 7 examined during the April through August spawning period under Alternative 1A would generally  
 8 be similar to or greater than flows under the NAA, except during July and August in the Sacramento,  
 9 Feather, and American rivers. Lower flows during these months in these rivers are not of sufficient  
 10 magnitude or frequency to have a biologically meaningful effect on threadfin shad. The percentage  
 11 of months below the spawning temperature threshold would generally be lower under Alternative  
 12 1A relative to the NAA.

1 **CEQA Conclusion:** In general, Alternative 1A would not affect the quality and quantity of upstream  
2 habitat conditions for threadfin shad relative to Existing Conditions.

### 3 **Flows**

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
5 Clear Creek were examined during April through August spawning period. Lower flows could reduce  
6 the quantity and quality of instream habitat (backwaters) available for spawning. However, this is  
7 unlikely to affect threadfin shad as they spawn on floating objects such as vegetation or wood which  
8 would float up or down with the flow regime (Moyle 2002).

9 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT during April through June  
10 would generally be similar to or greater than flows under Existing Conditions, except in wet years  
11 during May (14% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
12 Flows under A1A\_LLT during July and August would generally be lower than flows under Existing  
13 Conditions by up to 24%. Although numbers are small as indicated by screw trap catches at Red  
14 Bluff Diversion Dam where 1,260 threadfin shad were caught out of a total of 857,727 total fish  
15 caught (Gaines and Martin 2001).

16 Threadfin shad are not known from the Trinity River system (Pinnix et al. 2010).

17 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would nearly always be similar to or  
18 greater than flows under Existing Conditions throughout the period, except in critical years during  
19 August (17% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

20 Threadfin shad are not known from Clear Creek screw trap data (Gaines and Martin 2001;  
21 Greenwald et al. 2003; Earley et al. 2008a, 2008b, 2009, 2010).

22 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater (up to  
23 204% greater) than flows under Existing Conditions during April through June and lower (up to  
24 56% lower) during July and August (Appendix 11C, CALSIM II Model Results utilized in the Fish  
25 Analysis).

26 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to flows  
27 under Existing Conditions during April and June with some exceptions (up to 31% lower), and lower  
28 during May, July, and August (up to 49% lower) (Appendix 11C, CALSIM II Model Results utilized in  
29 the Fish Analysis).

30 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
31 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
32 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
33 flows during the period relative to Existing Conditions.

### 34 **Water Temperature**

35 The percentage of months below 68°F water temperature threshold for the April through August  
36 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
37 and Stanislaus rivers. Water temperatures below this threshold could delay spawning in these areas.  
38 According to Moyle (2002) the peak of spawning occurs at a temperature of 68°F, although  
39 spawning has been observed to occur from 57°F to 64°F. This makes it likely that threadfin shad can  
40 spawn successfully at much lower temperatures than 68°F, although their larval survival rate is

1 higher (0.6 vs. 0.8) at above 66°F (Betsill and Avyle 1997). Water temperatures were not modeled in  
2 the San Joaquin River or Clear Creek.

3 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
4 the range would be similar to or lower than the percentage under Existing Conditions in all water  
5 year types (Table 11-1A-91). Although numbers are small as indicated by screw trap catches at Red  
6 Bluff Diversion Dam where 1,260 threadfin shad were caught out of a total of 857,727 total fish  
7 caught (Gaines and Martin 2001).

8 Threadfin shad are not known from the Trinity River system (Pinnix et al. 2010).

9 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT below the  
10 68°F water temperature threshold would be lower than the percentage under Existing Conditions in  
11 all water year types (Table 11-1A-91).

12 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT below the 68°F  
13 water temperature threshold would be similar to or lower than the percentage under Existing  
14 Conditions in all water year types (Table 11-1A-91).

15 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT below  
16 the 68°F water temperature threshold would be similar to or lower than the percentage under  
17 Existing Conditions in all water year types (Table 11-1A-91).

18 Collectively, these results indicate that the impact would be less than significant because Alternative  
19 1A would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all  
20 rivers examined during the April through August spawning period under Alternative 1A would  
21 generally be similar to or greater than flows under Existing Conditions, except during summer  
22 months in the Sacramento, Feather, and American rivers. Lower flows during these months in the  
23 Sacramento and Feather rivers would not be of sufficient magnitude or frequency to cause a  
24 biologically meaningful effect on threadfin shad. Lower flows in the American River would occur  
25 during the majority of the period, but, due to the spatial diversity and movement ability of threadfin  
26 shad, these reductions are not expected to have a biologically meaningful effect on threadfin shad.  
27 The percentage of months outside all temperature thresholds are generally lower under Alternative  
28 1A than under Existing Conditions, indicating that there would be a net temperature-related benefit  
29 of Alternative 1A to threadfin shad.

### 30 **Largemouth Bass**

31 In general, Alternative 1A would not affect the quality and quantity of upstream habitat conditions  
32 for largemouth bass relative to the NAA. The primary distribution of largemouth bass is in the  
33 central and south Delta, although they do occur in slower moving parts of the rivers, their tributaries  
34 and reservoirs. Given this fact it is unlikely that upstream flows and temperatures will have a  
35 discernible effect on largemouth bass population numbers.

### 36 **Flows**

37 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
38 Clear Creek were examined during the March through June largemouth bass spawning period.  
39 Lower flows could increase the quantity and quality of instream spawning habitat.

40 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
41 or greater than flows under NAA during March through June (Appendix 11C, CALSIM II Model

1 Results utilized in the Fish Analysis). Although few largemouth bass are expected to occur in this  
2 area, as indicated by screw trap catches at Red Bluff Diversion Dam where 185 largemouth bass  
3 were caught out of a total of 857,727 total fish caught (Gaines and Martin 2001).

4 In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
5 or greater than flows under NAA during March through June, except in above normal years during  
6 April (11% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
7 Largemouth bass were not found in Trinity River screw trap data (Pinnix et al. 2010), but are  
8 apparently found in low numbers when washed down from upstream reservoirs (USFWS and Hoopa  
9 Valley Tribe 1999).

10 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
11 than flows under NAA during March through June, except in critical years during June (8% lower)  
12 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Largemouth bass are caught  
13 in rotary screw traps in low numbers mostly in the fry form (Gaines and Martin 2001) most likely  
14 washed down from Whiskeytown Reservoir or local farm ponds. It is unlikely that these largemouth  
15 bass rear and spawn except in the lowest velocity areas of lower Clear Creek where they are most  
16 likely flushed out of the system by high flow events (Moyle 2002).

17 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would be substantially greater  
18 (up to 219% greater) than flows under NAA during March through June (Appendix 11C, CALSIM II  
19 Model Results utilized in the Fish Analysis).

20 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
21 greater than flows under NAA throughout the period, except in dry and critical years during March  
22 (9% and 8% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish  
23 Analysis).

24 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
25 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
26 fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
27 the NAA.

### 28 ***Water Temperature***

29 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
30 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
31 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
32 reduced spawning success. Although Kelley (1968) found no difference in incubation survival of  
33 largemouth bass eggs in the temperature range of 55°F to 75°F. Thus it is unlikely that there would  
34 be reduced spawning success because of low temperatures. Water temperatures were not modeled  
35 in the San Joaquin River or Clear Creek.

36 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
37 the range would be similar to or lower than the percentage under NAA in below normal and critical  
38 water years and higher in all other water year types (up to 8% higher) (Table 11-1A-92). Although  
39 numbers are small as indicated by screw trap catches at Red Bluff Diversion Dam where 185  
40 largemouth were caught out of a total of 857,727 total fish caught (Gaines and Martin 2001).

1 In the Trinity River below Lewiston Reservoir, the percentage of months under A1A\_LLT outside the  
2 range would be similar to or lower than the percentage under NAA in all water years except critical  
3 years (5% higher) (Table 11-1A-92). Largemouth bass were not found in Trinity River screw trap  
4 data (Pinnix et al. 2010), but are apparently found in low numbers when washed down from  
5 upstream reservoirs (U.S. Fish and Wildlife Service and Hoopa Valley Tribe 1999).

6 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
7 the range would be similar to or lower than the percentage under NAA in all water year types (Table  
8 11-1A-92).

9 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
10 59°F to 75°F water temperature range would be similar to or lower than the percentage under NAA  
11 in all water years except critical years (8% higher) (Table 11-1A-92).

12 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
13 the range would be similar to or lower than the percentage under NAA in all water year types (Table  
14 11-1A-92).

1 **Table 11-1A-92. Difference and Percent Difference in the Percentage of Months during March–**  
 2 **June in Which Water Temperatures Are outside the 59°F to 75°F Water Temperature Range for**  
 3 **Largemouth Bass Spawning<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LL1	NAA vs. A1A_LL1
Sacramento River upstream of Red Bluff	Wet	-9 (-10%)	6 (8%)
	Above Normal	-9 (-10%)	4 (5%)
	Below Normal	-14 (-15%)	1 (1%)
	Dry	-12 (-12%)	4 (5%)
	Critical	-17 (-19%)	0 (-1%)
	All	-12 (-13%)	4 (5%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	-2 (-2%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	-1 (-1%)	0 (0%)
	Critical	-13 (-13%)	4 (5%)
	All	-2 (-2%)	1 (1%)
Feather River below Thermalito Afterbay	Wet	-9 (-16%)	0 (0%)
	Above Normal	-20 (-41%)	-7 (-23%)
	Below Normal	-14 (-32%)	-4 (-12%)
	Dry	-18 (-38%)	0 (0%)
	Critical	-17 (-38%)	-6 (-23%)
	All	-15 (-30%)	-2 (-7%)
American River below Nimbus Dam	Wet	-21 (-35%)	0 (0%)
	Above Normal	-18 (-38%)	0 (0%)
	Below Normal	-18 (-38%)	-2 (-6%)
	Dry	-11 (-30%)	0 (0%)
	Critical	-8 (-25%)	2 (8%)
	All	-16 (-34%)	0 (0%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	-2 (-2%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 1A would reduce the quality and quantity of upstream  
 6 habitat conditions for largemouth bass relative to Existing Conditions. Although at most this would  
 7 be a minor effect as largemouth bass are not abundant in this area and the main distribution of this  
 8 species abundance is found downstream of this area.

1 **Flows**

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3 Clear Creek were examined during the March through June largemouth bass spawning period.  
4 Lower flows could reduce the quantity and quality of instream spawning habitat.

5 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
6 or greater than flows under Existing Conditions during March through June, except in wet years  
7 during May (14% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
8 Although numbers are small as indicated by screw trap catches at Red Bluff Diversion Dam where  
9 185 largemouth bass were caught out of a total of 857,727 total fish caught (Gaines and Martin  
10 2001).

11 In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
12 or greater than flows under Existing Conditions during March through June, except in below normal  
13 years during March and critical years during May (6% lower in both) (Appendix 11C, CALSIM II  
14 Model Results utilized in the Fish Analysis). Largemouth bass were not found in Trinity River screw  
15 trap data (Pinnix et al. 2010), but are apparently found in low numbers when washed down from  
16 upstream reservoirs (U.S. Fish and Wildlife Service and Hoopa Valley Tribe 1999).

17 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would always be similar to or greater  
18 than flows under Existing Conditions during March through June (Appendix 11C, CALSIM II Model  
19 Results utilized in the Fish Analysis). Largemouth bass are caught in rotary screw traps in low  
20 numbers mostly in the fry form (Gaines and Martin 2001) most likely washed down from  
21 Whiskeytown Reservoir or local farm ponds. It is unlikely that these largemouth bass rear and  
22 spawn except in the lowest velocity areas of lower Clear Creek where they are most likely flushed  
23 out of the system by high flow events (Moyle 2002).

24 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be substantially  
25 greater (up to 204% greater) than flows under Existing Conditions during March through June,  
26 except in below normal years during March (31% lower) and wet years during May (28% lower)  
27 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

28 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
29 greater than flows under Existing Conditions during March, April, and June, except in critical years  
30 during March and June (8% and 31% lower, respectively), above normal years during April (6%  
31 lower) and wet years during June (24% lower). Flows under A1A\_LLT in May would generally be up  
32 to 24% lower than those under Existing Conditions (Appendix 11C, CALSIM II Model Results utilized  
33 in the Fish Analysis).

34 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
35 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
36 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
37 flows during the period relative to Existing Conditions.

38 **Water Temperature**

39 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
40 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
41 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
42 reduced spawning success. Kelley (1968) found no difference in incubation survival of largemouth

1 bass eggs in the temperature range of 55°F to 75°F. This would seem to make it unlikely that there  
2 would be reduced spawning success because of low temperatures. Water temperatures were not  
3 modeled in the San Joaquin River or Clear Creek.

4 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
5 the range would be lower than the percentage under Existing Conditions in all water years (Table  
6 11-1A-92). Although numbers are small as indicated by screw trap catches at Red Bluff Diversion  
7 Dam where 185 largemouth bass were caught out of a total of 857,727 total fish caught (Gaines and  
8 Martin 2001).

9 Trinity River below Lewiston Reservoir, the percentage of months under A1A\_LLT outside the range  
10 would be similar to or lower than the percentage under Existing Conditions in all water year types  
11 (Table 11-1A-92). Largemouth bass were not found in Trinity River screw trap data (Pinnix et al.  
12 2010), but are apparently found in low numbers when washed down from upstream reservoirs (U.S.  
13 Fish and Wildlife Service and Hoopa Valley Tribe 1999).

14 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
15 the range would be lower than the percentage under Existing Conditions in all water years except  
16 critical years (8% higher) (Table 11-1A-92).

17 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside of the  
18 59°F to 75°F water temperature range would be lower than the percentage under Existing  
19 Conditions in all water years (Table 11-1A-92).

20 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
21 the range would be similar to or lower than the percentage under Existing Conditions in all water  
22 year types (Table 11-1A-92).

### 23 **Sacramento Tule Perch**

24 In general, Alternative 1A would not affect the quality and quantity of upstream habitat conditions  
25 for Sacramento tule perch relative to the NAA.

### 26 **Flows**

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
28 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
29 reduce the quantity and quality of instream habitat available for rearing. Sacramento tule perch are  
30 well adapted to high and low flows of the natural hydrograph in California streams (Baltz and Moyle  
31 1982). It is unlikely that flows going up or down 10 percent or more would have a great impact on  
32 this species as it is well adapted to the wet winters and dry summers of the natural California  
33 climate. Also, Sacramento tule perch are a deep-bodied and laterally compressed fish, which is a  
34 body form not conducive to maintaining position in high velocity current without great effort (Cech  
35 et al. 1990). Unless lower flows increase high velocity habitat there is likely to be no effect on  
36 Sacramento tule perch, which prefer lower velocity high oxygenated habitats (Moyle and Baltz  
37 1985).

38 Upstream of Red Bluff, Sacramento River flows under A1A\_LLT in August, September, and  
39 November would be lower than flows under NAA (up to 44% lower), and generally similar to or  
40 greater than flows during the rest of the year, with some exceptions (up to 11% lower) (Appendix  
41 11C, CALSIM II Model Results utilized in the Fish Analysis). Numbers as indicated by screw trap

1 catches at Red Bluff Diversion Dam are small where 77 tule perch were caught out of a total of  
2 857,727 total fish caught (Gaines and Martin 2001).

3 Sacramento tule perch are not found in the Trinity River (Pinnix et al. 2010), or within the Klamath  
4 Province (Moyle 2002).

5 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
6 than NAA throughout the year, except in critical years during June and September (8% and 13%  
7 lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Numbers  
8 of Sacramento tule perch caught in screw traps are low with an average of less than 2 caught over an  
9 8-year period (Gaines and Martin 2001; Greenwald et al. 2003; Earley et al. 2008a, 2008b, 2009,  
10 2010).

11 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
12 those under NAA during October through June (up to 219% greater) and lower during July through  
13 September (up to 86% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

14 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be greater than flows  
15 under NAA during May, June, and October (up to 37% greater), generally lower during July through  
16 September (up to 47% lower), and generally similar during the remaining months (Appendix 11C,  
17 CALSIM II Model Results utilized in the Fish Analysis).

18 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
19 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
20 fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
21 the NAA.

## 22 ***Water Temperature***

23 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-  
24 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,  
25 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds  
26 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water  
27 temperatures were not modeled in the San Joaquin River or Clear Creek.

28 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT above the  
29 72°F threshold would be similar to the percentage under NAA in all water years except critical years  
30 (16% higher) (Table 11-1A-93). These relative differences, however, represent very low  
31 percentages of years (<1%). Therefore, these differences would not be biologically meaningful to  
32 Sacramento tule perch. Numbers as indicated by screw trap catches at Red Bluff Diversion Dam are  
33 small where 77 Sacramento tule perch were caught out of a total of 857,727 total fish caught (Gaines  
34 and Martin 2001).

35 Sacramento tule perch are not found in Trinity River screw trap data (Pinnix et al. 2010), or within  
36 the Klamath Province (Moyle 2002).

37 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT above the  
38 72°F threshold would be higher than the percentage under NAA in all water year types (up to 700%  
39 higher) (Table 11-1A-93).

40 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT above the 72°F  
41 threshold would be higher than the percentage under NAA in almost all water year types (up to

1 150% higher) (Table 11-1A-93). These relative differences, however, represent very low  
2 percentages of years (<3%). Therefore, these differences would not be biologically meaningful to  
3 Sacramento tule perch.

4 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT above  
5 the 72°F threshold would be similar to the percentage under NAA in all water year types (Table 11-  
6 1A-93).

7 **Table 11-1A-93. Difference and Percent Difference in the Percentage of Months in Which Year-  
8 Round Water Temperatures Exceed 72°F and 75°F Water Temperature Thresholds for Sacramento  
9 Tule Perch Occurrence<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
<b>72°F Threshold</b>			
Sacramento River upstream of Red Bluff	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	3 (NA)	1 (16%)
	All	1 (NA)	0.1 (16%)
Trinity River below Lewiston Reservoir	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	3 (NA)	1 (25%)
	All	0 (NA)	0.1 (25%)
Feather River below Thermalito Afterbay	Wet	6 (257%)	6 (76%)
	Above Normal	5 (NA)	5 (86%)
	Below Normal	11 (NA)	8 (72%)
	Dry	12 (NA)	6 (56%)
	Critical	14 (333%)	3 (19%)
	All	9 (677%)	6 (56%)
American River below Nimbus Dam	Wet	2 (NA)	0.3 (17%)
	Above Normal	2 (NA)	1 (33%)
	Below Normal	3 (NA)	-1 (-20%)
	Dry	10 (NA)	3 (32%)
	Critical	20 (414%)	1 (3%)
	All	7 (929%)	1 (13%)
Stanislaus River below New Melones Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
<b>75°F Threshold</b>			
Sacramento River upstream of Red Bluff	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	-0.1 (-500%)
	All	0 (NA)	-0.02 (-500%)
Trinity River below Lewiston Reservoir	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	Wet	1 (NA)	1 (100%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	2 (100%)
	Dry	3 (NA)	2 (67%)
	Critical	6 (900%)	0 (0%)
	All	2 (2,000%)	1 (43%)
American River below Nimbus Dam	Wet	1 (NA)	-0.3 (-50%)
	Above Normal	1 (NA)	1 (100%)
	Below Normal	1 (NA)	1 (100%)
	Dry	4 (NA)	2 (63%)
	Critical	12 (850%)	1 (5%)
	All	3 (1,450%)	1 (23%)
Stanislaus River below New Melones Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

1

2 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
3 Alternative 1A would not cause a substantial reduction in rearing habitat. Flows under Alternative  
4 1A in all rivers examined throughout the year are generally similar to or greater than flows under  
5 the NAA, except during summer months in the Feather River and half the year in the American River.  
6 These reductions in flows, however, would not result in an overall biologically meaningful effect on  
7 Sacramento tule perch. The percentages of years outside all temperature thresholds under  
8 Alternative 1A are generally similar to the percentages under the NAA. Some increases in  
9 percentage of years outside temperature ranges under Alternative 1A would occur, but they would  
10 generally be small (<5% on an absolute scale) and would not affect Sacramento tule perch habitat at  
11 a population level.

1 **CEQA Conclusion:** In general, Alternative 1A would not reduce the quality and quantity of upstream  
2 habitat conditions for Sacramento tule perch relative to Existing Conditions.

3 **Flows**

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
5 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
6 reduce the quantity and quality of instream habitat available for rearing. Sacramento tule perch are  
7 well adapted to high and low flows of the natural hydrograph in California streams (Baltz and Moyle  
8 1982). It is unlikely that flows going up or down 10 percent or more would have a great impact on  
9 this species as it is well adapted to the wet winters and dry summers of the natural California  
10 climate. Also, Sacramento tule perch are a deep-bodied and laterally compressed fish, a body form  
11 not conducive for maintaining position in high velocity current area without great effort (Cech et al.  
12 1990). Unless lower flows increase high velocity habitat there is likely to be no effect on Sacramento  
13 tule perch, which prefer lower velocity high oxygenated habitats (Moyle and Baltz 1985).

14 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
15 or greater than flows under Existing Conditions during all months but July through September and  
16 November, except in wet years during May (14% lower) (Appendix 11C, CALSIM II Model Results  
17 utilized in the Fish Analysis). Flows under A1A\_LLT during July through September and November  
18 would be lower than flows under Existing Conditions (up to 24% lower). Numbers as indicated by  
19 screw trap catches at Red Bluff Diversion Dam are small where 77 tule perch were caught out of a  
20 total of 857,727 total fish caught (Gaines and Martin 2001).

21 Sacramento tule perch are not found in Trinity River screw trap data (Pinnix et al. 2010), or within  
22 the Klamath Province (Moyle 2002).

23 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
24 than flows under Existing Conditions throughout the year, except in critical years during August and  
25 September (17% and 38% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in  
26 the Fish Analysis). Numbers of Sacramento tule perch caught in screw traps are low with an average  
27 of less than 2 tule perch caught over an 8-year period (Gaines and Martin 2001; Greenwald et al.  
28 2003; Earley et al. 2008a, 2008b, 2009, 2010).

29 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
30 those under Existing Conditions during February through June, October, and December (up to 204%  
31 greater), lower during July through September (up to 56% lower), and similar during November and  
32 January (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

33 In the American River at Nimbus Dam, flows under A1A\_LLT would generally greater than flows  
34 under Existing Conditions during February, March, and October (up to 42% greater), lower during  
35 January, May, July through September, and November through December (up to 53% lower), and  
36 generally similar during the rest of the year (Appendix 11C, CALSIM II Model Results utilized in the  
37 Fish Analysis).

38 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
39 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
40 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
41 flows during the period relative to Existing Conditions.

1 **Water Temperature**

2 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round  
3 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,  
4 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead  
5 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not  
6 modeled in Clear Creek or the San Joaquin River.

7 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LL1 above the  
8 72°F threshold would be similar to the percentage under Existing Conditions in all water years  
9 (Table 11-1A-93). Numbers as indicated by screw trap catches at Red Bluff Diversion Dam are small  
10 where 77 tule perch were caught out of a total of 857,727 total fish caught (Gaines and Martin  
11 2001).

12 Sacramento tule perch are not found in Trinity River screw trap data (Pinnix et al. 2010), or within  
13 the Klamath Province (Moyle 2002).

14 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LL1 above the  
15 72°F threshold would be similar to or higher than the percentage under Existing Conditions in all  
16 water year types (up to 333% higher) (Table 11-1A-93).

17 In the American River below Nimbus Dam, the percentage of months under A1A\_LL1 above the 72°F  
18 threshold would be similar to or higher than the percentage under Existing Conditions in almost all  
19 water year types (up to 414% higher) (Table 11-1A-93). The relative differences predicted in wet,  
20 above normal, and below normal years, however, represent low percentages of years (<3%).  
21 Therefore, these differences would not be biologically meaningful to Sacramento tule perch.

22 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LL1 above  
23 the 72°F threshold would be similar to the percentage under Existing Conditions in all water year  
24 types (Table 11-1A-93).

25 Collectively, the results of the Impact AQUA-202 CEQA analysis indicate that the difference between  
26 the CEQA baseline and Alternative 1A could be significant because the alternative could  
27 substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above.  
28 There would be small to moderate flow-related effects and temperature-related effects of  
29 Alternative 1A on Sacramento tule perch in the American and Feather rivers. Flow reductions and  
30 increases in exceedances above temperature thresholds would have a biologically meaningful effect  
31 on the population. This impact is a result of the specific reservoir operations and resulting flows  
32 associated with this alternative. These results are primarily caused by four factors: differences in sea  
33 level rise, differences in climate change, future water demands, and implementation of the  
34 alternative. The analysis described above comparing Existing Conditions to Alternative 1A does not  
35 partition the effect of implementation of the alternative from those of sea level rise, climate change  
36 and future water demands using the model simulation results presented in this chapter. However,  
37 the increment of change attributable to the alternative is well informed by the results from the  
38 NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been  
39 conducted for Existing Conditions in the LL1 implementation period, which does include future sea  
40 level rise, climate change, and water demands. Therefore, the comparison of results between the  
41 alternative and Existing Conditions in the LL1, both of which include sea level rise, climate change,  
42 and future water demands, isolates the effect of the alternative from those of sea level rise, climate  
43 change, and water demands.

1 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
2 term implementation period and Alternative 1A indicates that flows in the locations and during the  
3 months analyzed above would generally be similar between future conditions without BDCP and  
4 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
5 found above would generally be due to climate change, sea level rise, and future demand, and not  
6 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
7 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
8 result in a significant impact on rearing habitat for Sacramento tule perch. This impact is found to be  
9 less than significant and no mitigation is required.

10 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
11 using two unique baselines. The NEPA conclusion was based on the comparison of A1A\_LLT with  
12 NAA and the CEQA conclusion was based on the comparison of A1A\_LLT with Existing Conditions.  
13 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
14 water years whereas Existing Conditions do not. Second, the NAA is assumed to occur during the  
15 late long-term implementation period whereas the CEQA baseline is assumed to occur during  
16 existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and  
17 the Alternative 1A are due to both the alternative and future climate change.

### 18 **Sacramento-San Joaquin Roach**

19 In general, Alternative 1A would not affect the quality and quantity of upstream habitat conditions  
20 for Sacramento-San Joaquin Roach relative to the NAA.

#### 21 ***Flows***

22 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
23 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
24 period. Lower flows might reduce the quantity and quality of instream habitat available for  
25 spawning. In a study of roach over a whole season Moyle and Baltz (1985) found them in habitats  
26 with flows averaging 0.2 m/s but ranging from 0.025m/s to 0.38 m/s. Roach are typically  
27 considered a foothill stream species and it is unlikely that their population numbers are dependent  
28 on the Sacramento River and large tributaries (Moyle 2002).

29 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
30 or greater than flows under NAA during March through June (Appendix 11C, CALSIM II Model  
31 Results utilized in the Fish Analysis). Numbers as indicated by screw trap catches at Red Bluff  
32 Diversion Dam are small where 275 Sacramento-San Joaquin roach were caught out of a total of  
33 857,727 total fish caught (Gaines and Martin 2001).

34 Sacramento-San Joaquin roach are not found in Trinity River screw trap data (Pinnix et al. 2010), or  
35 within the Klamath Province (Moyle 2002).

36 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
37 than flows under NAA during March through June, except in critical years during June (8% lower)  
38 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Numbers of Sacramento-San  
39 Joaquin roach caught in screw traps are low with an average of less than 45 caught over a 9-year  
40 period (Gaines and Martin 2001; Greenwald et al. 2003; Earley et al. 2008a, 2008b, 2009, 2010).

1 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would be substantially greater  
2 (up to 219% greater) than flows under NAA during March through June (Appendix 11C, CALSIM II  
3 Model Results utilized in the Fish Analysis).

4 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
5 greater than flows under NAA throughout the period, except in dry and critical years during March  
6 (9% and 8% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish  
7 Analysis).

8 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
9 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
10 fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
11 the NAA.

### 12 **Water Temperature**

13 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
14 Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
15 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
16 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
17 River or Clear Creek. The Sacramento River and its large tributaries are most likely not the primary  
18 habitat of Sacramento-San Joaquin roach. It is more likely that they are washed into these bigger  
19 streams from smaller tributaries which would likely be warmer than the below dam releases that  
20 are made for salmonid fishes.

21 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
22 the range would be lower than the percentage under NAA in all water year types (Table 11-1A-94).  
23 Numbers as indicated by screw trap catches at Red Bluff Diversion Dam are small where 275  
24 Sacramento-San Joaquin roach were caught out of a total of 857,727 total fish caught (Gaines and  
25 Martin 2001).

26 Sacramento-San Joaquin roach are not found in Trinity River screw trap data (Pinnix et al. 2010), or  
27 within the Klamath Province (Moyle 2002).

28 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
29 the range would be similar to or lower than the percentage under NAA in all water year types except  
30 below normal years (7% higher) (Table 11-1A-94).

31 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT below the  
32 60.8°F water temperature threshold would be similar to or lower than the percentage under NAA in  
33 all water year types (Table 11-1A-94).

34 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
35 the range would be similar to the percentage under NAA in all water year types (Table 11-1A-94).

1 **Table 11-1A-94. Difference and Percent Difference in the Percentage of Months during March–**  
 2 **June in Which Water Temperatures Fall below the 60.8°F Water Temperature Threshold Range for**  
 3 **the Initiation of Sacramento-San Joaquin Roach Spawning<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	-5 (-5%)	2 (3%)
	Above Normal	-3 (-3%)	4 (4%)
	Below Normal	-8 (-8%)	-1 (-1%)
	Dry	-3 (-3%)	2 (2%)
	Critical	-10 (-10%)	-1 (-1%)
	All	-5 (-5%)	1 (1%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	-2 (-2%)	0 (0%)
	Below Normal	-2 (-2%)	0 (0%)
	Dry	-3 (-3%)	0 (0%)
	Critical	-8 (-8%)	0 (0%)
	All	-2 (-2%)	0 (0%)
Feather River below Thermalito Afterbay	Wet	-13 (-19%)	0 (0%)
	Above Normal	-7 (-13%)	0 (0%)
	Below Normal	-2 (-4%)	4 (7%)
	Dry	-13 (-23%)	-1 (-3%)
	Critical	-19 (-33%)	-4 (-11%)
	All	-11 (-19%)	0 (-1%)
American River below Nimbus Dam	Wet	-22 (-32%)	0 (0%)
	Above Normal	-20 (-33%)	0 (0%)
	Below Normal	-23 (-36%)	0 (0%)
	Dry	-18 (-36%)	1 (4%)
	Critical	-15 (-30%)	0 (0%)
	All	-20 (-34%)	0.3 (1%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	0 (0%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 1A would reduce the quality and quantity of upstream  
 6 habitat relative to Existing Conditions, although these mainstem river changes are not likely affect  
 7 Sacramento-San Joaquin roach, which occur primarily in tributary areas.

8 **Flows**

9 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 10 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
 11 period. Lower flows could reduce the quantity and quality of instream habitat available for

1 spawning. In a study of roach over a whole season Moyle and Baltz (1985) found them in habitats  
2 with flows averaging 0.2 m/s but ranging from 0.025m/s to 0.38 m/s. Roach are typically  
3 considered a foothill stream species and it is unlikely that their population numbers are dependent  
4 on the Sacramento River and large tributaries (Moyle 2002).

5 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
6 or greater than flows under Existing Conditions during March through June, except in wet years  
7 during May (14% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
8 Numbers as indicated by screw trap catches at Red Bluff Diversion Dam are small where 275  
9 Sacramento-San Joaquin roach were caught out of a total of 857,727 total fish caught (Gaines and  
10 Martin 2001).

11 Sacramento-San Joaquin roach are not found in Trinity River screw trap data (Pinnix et al. 2010), or  
12 within the Klamath Province (Moyle 2002).

13 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would always be similar to or greater  
14 than flows under Existing Conditions during March through June (Appendix 11C, CALSIM II Model  
15 Results utilized in the Fish Analysis). Numbers of Sacramento-San Joaquin roach caught in screw  
16 traps are low with an average of less than 45 caught over a 9-year period (Gaines and Martin 2001;  
17 Greenwald et al. 2003; Earley et al. 2008a, 2008b, 2009, 2010).

18 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be substantially  
19 greater (up to 204% greater) than flows under Existing Conditions during March through June,  
20 except in below normal years during March (31% lower) and wet years during May (28% lower)  
21 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

22 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
23 greater than flows under Existing Conditions during March, April, and June, except in critical years  
24 during March and June (8% and 31% lower, respectively), above normal years during April (6%  
25 lower) and wet years during June (24% lower). Flows under A1A\_LLT in May would generally be up  
26 to 24% lower than those under Existing Conditions (Appendix 11C, CALSIM II Model Results utilized  
27 in the Fish Analysis).

28 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
29 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
30 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
31 flows during the period relative to Existing Conditions.

### 32 ***Water Temperature***

33 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
34 Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
35 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
36 delay spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear  
37 Creek. The Sacramento River and its large tributaries are most likely not the primary habitat of  
38 Sacramento-San Joaquin roach. It is more likely that they are washed into these bigger streams from  
39 smaller tributaries which would likely be warmer than the below dam releases that are made for  
40 salmonid fishes.

41 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT below the  
42 threshold would be lower than the percentage under Existing Conditions in all water years (Table

1 11-1A-94). Numbers as indicated by screw trap catches at Red Bluff Diversion Dam are small where  
2 275 Sacramento-San Joaquin roach were caught out of a total of 857,727 total fish caught (Gaines  
3 and Martin 2001).

4 Sacramento-San Joaquin roach are not found in Trinity River screw trap data (Pinnix et al. 2010), or  
5 within the Klamath Province (Moyle 2002).

6 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT below the  
7 threshold would be lower than the percentage under Existing Conditions in all water year types  
8 (Table 11-1A-94).

9 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT below the  
10 threshold would be lower than the percentage under Existing Conditions in all water years (Table  
11 11-1A-94).

12 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT below  
13 the threshold would be similar to the percentage under Existing Conditions in all water year types  
14 (Table 11-1A-94).

#### 15 **Hardhead**

16 In general, Alternative 1A would not affect the quality and quantity of upstream habitat conditions  
17 for hardhead relative to the NAA.

#### 18 **Flows**

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
20 Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
21 could reduce the quantity and quality of instream habitat available for spawning.

22 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
23 or greater than flows under NAA throughout the period (Appendix 11C, CALSIM II Model Results  
24 utilized in the Fish Analysis).

25 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
26 Province (Moyle 2002).

27 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would always to be similar to flows  
28 under NAA throughout the period regardless of water year type (Appendix 11C, CALSIM II Model  
29 Results utilized in the Fish Analysis).

30 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be substantially  
31 greater (up to 219% greater) than flows under NAA throughout the period (Appendix 11C, CALSIM  
32 II Model Results utilized in the Fish Analysis).

33 In the American River at Nimbus Dam, flows under A1A\_LLT would be similar to or greater than  
34 flows under NAA during April. During May, flows under A1A\_LLT would generally be greater than  
35 flows under NAA (up to 28% greater) (Appendix 11C, CALSIM II Model Results utilized in the Fish  
36 Analysis).

37 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
38 covered fish species under Alternative 1A (see AQUA-76, -77, and -78 under Chinook salmon fall-

1 /late-fall run ESU). That analysis indicates that there would be no differences in flows relative to the  
2 NAA.

3 ***Water Temperature***

4 The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
5 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
6 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
7 spawning success and increased egg and larval stress and mortality. Water temperatures were not  
8 modeled in the San Joaquin River or Clear Creek.

9 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
10 the range would be similar to or lower than the percentage under NAA in all water year except wet  
11 and dry years (5% and 9% higher, respectively) (Table 11-1A-95).

12 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
13 Province (Moyle 2002).

14 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
15 the range would be lower than the percentage under NAA in all water year (Table 11-1A-95).

16 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
17 59°F to 75°F water temperature range would be similar to or lower than the percentage under NAA  
18 in all water years except critical years (6% higher) (Table 11-1A-95).

19 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
20 the range would be similar to the percentage under NAA in all water year types (Table 11-1A-95).

1 **Table 11-1A-95. Difference and Percent Difference in the Percentage of Months during April–May**  
 2 **in Which Water Temperatures Are outside the 59°F to 64°F Water Temperature Range for**  
 3 **Hardhead Spawning<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	-10 (-11%)	4 (5%)
	Above Normal	-13 (-14%)	2 (2%)
	Below Normal	-15 (-16%)	0.5 (1%)
	Dry	-6 (-6%)	8 (9%)
	Critical	-15 (-16%)	0 (0%)
	All	-11 (-12%)	3 (4%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	0 (0%)	0 (0%)
	All	0 (0%)	0 (0%)
Feather River below Thermalito Afterbay	Wet	-6 (-9%)	-8 (-14%)
	Above Normal	-27 (-43%)	-18 (-50%)
	Below Normal	4 (8%)	-18 (-38%)
	Dry	-8 (-15%)	-3 (-6%)
	Critical	-8 (-15%)	-8 (-18%)
	All	-8 (-14%)	-10 (-21%)
American River below Nimbus Dam	Wet	-27 (-37%)	-4 (-8%)
	Above Normal	18 (40%)	0 (0%)
	Below Normal	4 (7%)	-4 (-7%)
	Dry	14 (29%)	-3 (-5%)
	Critical	38 (100%)	4 (6%)
	All	3 (6%)	-2 (-3%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	0 (0%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 1A would reduce the quality and quantity of upstream  
 6 habitat conditions for hardhead relative to Existing Conditions.

7 **Flows**

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 9 Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
 10 could reduce the quantity and quality of instream habitat available for spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
2 or greater than flows under Existing Conditions throughout the period, except in wet years during  
3 May (14% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

4 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
5 Province (Moyle 2002).

6 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would always be similar to or greater  
7 than flows under Existing Conditions throughout the period (Appendix 11C, CALSIM II Model  
8 Results utilized in the Fish Analysis).

9 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be similar to or  
10 greater than flows under Existing Conditions throughout the period, except in wet years during May  
11 (28% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

12 In the American River at Nimbus Dam, flows under A1A\_LLT would be similar to or greater than  
13 flows under Existing Conditions during April except in above normal years (6% lower) and  
14 generally up to 24% lower than flows under Existing Conditions during May (Appendix 11C, CALSIM  
15 II Model Results utilized in the Fish Analysis).

16 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
17 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
18 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
19 flows during the period relative to Existing Conditions.

#### 20 ***Water Temperature***

21 The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
22 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
23 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
24 spawning success and increased egg and larval stress and mortality. Water temperatures were not  
25 modeled in the San Joaquin River or Clear Creek.

26 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT below the  
27 threshold would be lower than the percentage under Existing Conditions in all water years (Table  
28 11-1A-95).

29 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
30 Province (Moyle 2002).

31 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT below the  
32 threshold would be lower than the percentage under Existing Conditions in all water years except  
33 below normal years (8% higher) (Table 11-1A-95).

34 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT below the  
35 threshold would be higher than the percentage under Existing Conditions in almost all water years  
36 (up to 100% higher) (Table 11-1A-95).

37 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT below  
38 the threshold would be similar to the percentage under Existing Conditions in all water year types  
39 (Table 11-1A-99).

1 **California Bay Shrimp**

2 **NEPA Effects:** For California bay shrimp the overall flows and temperature within the estuary would  
3 be neutral or slightly improved with respect to spawning. These conditions would not be adverse.

4 **CEQA Conclusion:** As described immediately above, the impacts of water operations on spawning  
5 conditions for California bay shrimp would not be significant and no mitigation is required.

6 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat of Non-Covered Aquatic  
7 Species of Primary Management Concern**

8 Refer to Impact AQUA-5 under delta smelt and Impact AQUA-41 under Chinook salmon for a  
9 discussion of the effects of water operations on rearing habitat of non-covered species of primary  
10 management concern. Although there are minor differences the effects are similar. Although Delta  
11 smelt and Chinook salmon are used for the purpose of comparing changes in flow and temperature  
12 it is recognized that non-covered species may use habitat differently and may respond differently to  
13 these changes. The conclusion from these comparisons for AQUA-5 and AQUA-41 of adverse from  
14 comparisons with Delta smelt and Chinook salmon are likely not adverse for non-covered species  
15 because of range, different uses of habitat, and differing temperature tolerance.

16 **Striped Bass**

17 **NEPA Effects:** Refer to Impact AQUA-5 under delta smelt and Impact AQUA-41 under Chinook  
18 salmon for a discussion of the effects of water operations on rearing habitat for striped bass. The  
19 potential effects would be similar to those described there. The effects would not be adverse.

20 **CEQA Conclusion:** As described above the impacts on striped bass rearing habitat would be less  
21 than significant.

22 **American Shad**

23 **NEPA Effects:** Refer to Impact AQUA-5 under delta smelt and Impact AQUA-41 under Chinook  
24 salmon for a discussion of the effects of water operations on rearing habitat for American shad. The  
25 potential effects would be similar to those described there. The effects would not be adverse.

26 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less  
27 than significant.

28 **Threadfin Shad**

29 **NEPA Effects:** Refer to Impact AQUA-5 under delta smelt and Impact AQUA-41 under Chinook  
30 salmon for a discussion of the effects of water operations on rearing habitat for threadfin shad. The  
31 potential effects would be similar to those described there. The effects would not be adverse.

32 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less  
33 than significant.

1 **Largemouth Bass**

2 ***Juveniles***

3 ***Flows***

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
5 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
6 period. Lower flows could reduce the quantity and quality of instream habitat (backwaters)  
7 available for juvenile rearing.

8 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
9 or greater than flows under NAA during April through July and October, with some exceptions (up to  
10 14% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows under  
11 A1A\_LLT during August, September, November, and July would be lower, by up to 42%, than NAA  
12 depending on month, water year type, and time period.

13 In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
14 or greater than flows under NAA during the April through November period with some exceptions  
15 (up to 42% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
16 Largemouth bass were not found in Trinity River screw trap data (Pinnix et al. 2010), but are  
17 apparently found in low numbers when washed down from upstream reservoirs (U.S. Fish and  
18 Wildlife Service and Hoopa Valley Tribe 1999).

19 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
20 than NAA throughout the year, except in critical years during June and September (8% and 13%  
21 lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

22 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be lower than  
23 those under NAA during July through September (up to 86% lower) and generally greater during  
24 April through June and October through November (up to 219% greater), with some exceptions (up  
25 to 28% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

26 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be lower than flows  
27 under NAA during July through September (up to 47% lower), greater during May, June, and  
28 October (up to 36% greater), and similar during April and November, with some exceptions (up to  
29 17% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

30 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
31 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
32 fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
33 the NAA.

34 ***Water Temperature***

35 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
36 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
37 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
38 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
39 temperatures were not modeled in the San Joaquin River or Clear Creek.

1 Water temperatures would not exceed 88°F under NAA or A1A\_LLT in any of the rivers examined  
 2 (Table 11-1A-96). As a result, there would be no difference in the percentage of months in which the  
 3 88°F water temperature threshold is exceeded between Alternative 1A and the NAA.

4 **Table 11-1A-96. Difference and Percent Difference in the Percentage of Months during April–**  
 5 **November in Which Water Temperatures Exceed the 88°F Water Temperature Threshold for**  
 6 **Juvenile Largemouth Bass Rearing<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Trinity River below Lewiston Reservoir	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
American River below Nimbus Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Stanislaus River below New Melones Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

7

1       **Adults**

2       *Flows*

3       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
4       Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows  
5       could reduce the quantity and quality of instream habitat available for adult rearing.

6       In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT during August, September, and  
7       November would be lower than flows under NAA (up to 44% lower), and generally similar to or  
8       greater than flows under NAA during the rest of the year, with some exceptions (up to 11% lower).  
9       (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

10       In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
11       or greater than flows under NAA with some exceptions (up to 11% lower) (Appendix 11C, CALSIM II  
12       Model Results utilized in the Fish Analysis). Largemouth bass were not found in Trinity River screw  
13       trap data (Pinnix et al. 2010), but are apparently found in low numbers when washed down from  
14       upstream reservoirs (U.S. Fish and Wildlife Service and Hoopa Valley Tribe 1999).

15       In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
16       than NAA throughout the year, except in critical years during June and September (8% and 13%  
17       lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

18       In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
19       those under NAA during October through June (up to 219% greater) and lower during July through  
20       September (up to 86% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

21       In the American River at Nimbus Dam, flows under A1A\_LLT would generally be greater than flows  
22       under NAA during May, June, and October (up to 37% greater), generally lower during July through  
23       September (up to 47% lower), and generally similar during the remaining months (Appendix 11C,  
24       CALSIM II Model Results utilized in the Fish Analysis).

25       Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
26       covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
27       fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
28       the NAA.

29       *Water Temperature*

30       The percentage of months above the 86°F water temperature threshold for year-round adult  
31       largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
32       Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
33       rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
34       modeled in the San Joaquin River or Clear Creek.

35       Water temperatures would not exceed 88°F under NAA or A1A\_LLT in any of the waterways  
36       examined (Table 11-1A-97). As a result, there would be no difference in the percentage of months in  
37       which the 86°F water temperature threshold is exceeded between Alternative 1A and the NAA.

1  
2  
3

**Table 11-1A-97. Difference and Percent Difference in the Percentage of Months in Which Year-Round Water Temperatures Exceed the 86°F Water Temperature Threshold for Adult Largemouth Bass Survival<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Trinity River below Lewiston Reservoir	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
American River below Nimbus Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Stanislaus River below New Melones Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

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**NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because Alternative 1A would not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all rivers examined during the year under Alternative 1A are generally similar to or greater than flows under the NAA in most months. Flows in July through September are generally lower in the Feather River high flow channel and in the American River below Nimbus Dam, although these reductions would not be biologically meaningful to the largemouth bass population due to the high mobility and diverse distribution of largemouth bass in the Central Valley. The

1 percentage of months outside all temperature thresholds in all locations examined under  
2 Alternative 1A are generally similar to or lower than under the NAA.

3 **CEQA Conclusion:** In general, Alternative 1A would reduce the quality and quantity of upstream  
4 habitat conditions for largemouth bass relative to Existing Conditions.

### 5 **Juveniles**

#### 6 *Flows*

7 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
8 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
9 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
10 rearing.

11 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
12 or greater than flows under Existing Conditions in all months but July through September and  
13 November with some exceptions (up to 14% lower) (Appendix 11C, CALSIM II Model Results  
14 utilized in the Fish Analysis). Flows during July through September and November under A1A\_LLT  
15 would be up to 24% lower than flows under Existing Conditions.

16 In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT during April through  
17 November would generally be similar to or greater than flows under Existing Conditions throughout  
18 the period with some exceptions (up to 42% lower), except during October and November  
19 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows under A1A\_LLT during  
20 October and November would be up to 25% lower than flows under Existing Conditions.  
21 Largemouth bass were not found in Trinity River screw trap data (Pinnix et al. 2010), but are  
22 apparently found in low numbers when washed down from upstream reservoirs (USFWS and Hoopa  
23 Valley Tribe 1999).

24 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
25 than flows under Existing Conditions throughout the April through November period, except in  
26 critical years during August and September (17% to 38% lower, respectively) (Appendix 11C,  
27 CALSIM II Model Results utilized in the Fish Analysis).

28 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater (up to  
29 204% greater) than flows under Existing Conditions during April through June and October, lower  
30 (up to 56% lower) during July through September, and similar during November (Appendix 11C,  
31 CALSIM II Model Results utilized in the Fish Analysis).

32 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be similar to or  
33 greater than flows under Existing Conditions during April, June, and October, with some exceptions  
34 (up to 31% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows  
35 under A1A\_LLT during the rest of the period would be lower by up to 53% and.

36 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
37 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
38 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
39 flows during the period relative to Existing Conditions.

1        *Water Temperature*

2        The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
3        rearing during April through November was examined in the Sacramento, Trinity, Feather,  
4        American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
5        quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
6        temperatures were not modeled in the San Joaquin River or Clear Creek.

7        The analysis indicates that there would be no temperature-related effects in in the Sacramento,  
8        Trinity, American, and Stanislaus rivers during the April through November period. Water  
9        temperatures would not exceed 88°F under Existing Conditions or A1A\_LLT in all waterways  
10       examined (Table 11-1A-97). As a result, there would be no difference in the percentage of months in  
11       which the 88°F water temperature threshold is exceeded between Alternative 1A and Existing  
12       Conditions.

13       **Adults**

14       *Flows*

15       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
16       Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower  
17       flows could reduce the quantity and quality of instream habitat available for adult rearing.

18       In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
19       or greater than flows under Existing Conditions during all months but July through September and  
20       November, except in wet years during May (14% lower) (Appendix 11C, CALSIM II Model Results  
21       utilized in the Fish Analysis). Flows under A1A\_LLT during July through September and November  
22       would be lower than flows under Existing Conditions (up to 24% lower).

23       In the Trinity River below Lewiston Reservoir, flows under A1A\_LLT would generally be similar to  
24       or greater than flows under Existing Conditions throughout the year with some exceptions (up to  
25       42% lower), except during October through December when it would generally be lower (up to 25%  
26       lower during both months) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).  
27       Largemouth bass were not found in Trinity River screw trap data (Pinnix et al. 2010), but are  
28       apparently found in low numbers when washed down from upstream reservoirs (USFWS and Hoopa  
29       Valley Tribe 1999).

30       In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
31       than flows under Existing Conditions throughout the year, except in critical years during August and  
32       September (17% and 38% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in  
33       the Fish Analysis).

34       In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
35       those under Existing Conditions during February through June, October, and December (up to 204%  
36       greater), lower during July through September (up to 56% lower), and similar during November and  
37       January (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

1 In the American River at Nimbus Dam, flows under A1A\_LLT would generally greater than flows  
2 under Existing Conditions during February, March, and October (up to 42% greater), lower during  
3 January, May, July through September, and November through December (up to 53% lower), and  
4 generally similar during the rest of the year (Appendix 11C, CALSIM II Model Results utilized in the  
5 Fish Analysis).

6 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
7 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
8 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
9 flows during the period relative to Existing Conditions.

#### 10 *Water Temperature*

11 The percentage of months above the 86°F water temperature threshold for year-round adult  
12 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
13 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
14 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
15 modeled in the San Joaquin River or Clear Creek.

16 Water temperatures would not exceed 86°F under Existing Conditions or A1A\_LLT in all waterways  
17 examined (Table 11-1A-97). As a result, there would be no difference in the percentage of months in  
18 which the 86°F water temperature threshold is exceeded between Alternative 1A and Existing  
19 Conditions.

20 Collectively, the results of the Impact AQUA-202 CEQA analysis indicate that the difference between  
21 the CEQA baseline and Alternative 1A could be significant because, under the CEQA baseline, the  
22 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA  
23 conclusion set forth above. There would be small to moderate flow-related effects and temperature-  
24 related effects of Alternative 1A on Sacramento tule perch in the American and Feather rivers. Flow  
25 reductions and increases in exceedances above temperature thresholds would have a biologically  
26 meaningful effect on the population. This impact is a result of the specific reservoir operations and  
27 resulting flows associated with this alternative. These results are primarily caused by four factors:  
28 differences in sea level rise, differences in climate change, future water demands, and  
29 implementation of the alternative. The analysis described above comparing Existing Conditions to  
30 Alternative 1A does not partition the effect of implementation of the alternative from those of sea  
31 level rise, climate change and future water demands using the model simulation results presented in  
32 this chapter. However, the increment of change attributable to the alternative is well informed by  
33 the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM  
34 modeling has been conducted for Existing Conditions in the LLT implementation period, which does  
35 include future sea level rise, climate change, and water demands. Therefore, the comparison of  
36 results between the alternative and Existing Conditions in the LLT, both of which include sea level  
37 rise, climate change, and future water demands, isolates the effect of the alternative from those of  
38 sea level rise, climate change, and water demands.

39 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
40 term implementation period and Alternative 1A indicates that flows in the locations and during the  
41 months analyzed above would generally be similar between future conditions without BDCP and  
42 Alternative 1A. This indicates that the differences between Existing Conditions and Alternative 1A  
43 found above would generally be due to climate change, sea level rise, and future demand, and not  
44 the alternative. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea

1 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
2 result in a significant impact on rearing habitat for Sacramento tule perch. This impact is found to be  
3 less than significant and no mitigation is required.

4 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
5 using two unique baselines. The NEPA conclusion was based on the comparison of A1A\_LLT with  
6 NAA and the CEQA conclusion was based on the comparison of A1A\_LLT with Existing Conditions.  
7 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
8 water years whereas Existing Conditions do not. Second, the NAA is assumed to occur during the  
9 late long-term implementation period whereas the CEQA baseline is assumed to occur during  
10 existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and  
11 the Alternative 1A are due primarily to both the alternative and future climate change.

## 12 **Sacramento Tule Perch**

13 **NEPA Effects:** Refer to Impact AQUA-5 under delta smelt and Impact AQUA-41 under Chinook  
14 salmon for a discussion of the effects of water operations on rearing habitat for Sacramento tule  
15 perch. The potential effects would be similar to those described there. The effects would not be  
16 adverse.

17 **CEQA Conclusion:** As described above the impacts on Sacramento tule perch rearing habitat would  
18 be less than significant.

## 19 **Sacramento-San Joaquin Roach**

### 20 **Flows**

21 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
22 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
23 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
24 rearing. The Sacramento River and its large tributaries are most likely not the primary habitat of  
25 Sacramento-San Joaquin roach. It is more likely that they are washed into these bigger streams from  
26 smaller tributaries which would likely be warmer than the below dam releases that are made for  
27 salmonid fishes.

28 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT during August, September, and  
29 November would be lower than flows under NAA (up to 44% lower), and generally similar to or  
30 greater than flows under NAA during the rest of the year, with some exceptions (up to 11% lower).  
31 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

32 Sacramento-San Joaquin roach are not found in Trinity River screw trap data (Pinnix et al. 2010), or  
33 within the Klamath Province (Moyle 2002).

34 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
35 than NAA throughout the year, except in critical years during June and September (8% and 13%  
36 lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

1 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
2 those under NAA during October through June (up to 219% greater) and lower during July through  
3 September (up to 86% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

4 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be greater than flows  
5 under NAA during May, June, and October (up to 37% greater), generally lower during July through  
6 September (up to 47% lower), and generally similar during the remaining months (Appendix 11C,  
7 CALSIM II Model Results utilized in the Fish Analysis).

8 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
9 covered fish species under Alternative 1A (see Impacts AQUA-76–through 78 under Chinook salmon  
10 fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows relative to  
11 the NAA.

### 12 ***Water Temperature***

13 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
14 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
15 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing  
16 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San  
17 Joaquin River or Clear Creek.

18 Water temperatures would not exceed 86°F under NAA or A1A\_LLT in any of the waterways  
19 examined (Table 11-1A-98). As a result, there would be no difference in the percentage of months in  
20 which the 86°F water temperature threshold is exceeded between Alternative 1A and NAA.

1 **Table 11-1A-98. Difference and Percent Difference in the Percentage of Months in Which Year-**  
 2 **Round Water Temperatures Exceed the 86°F Water Temperature Range for Sacramento-San**  
 3 **Joaquin Roach Survival<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LL1	NAA vs. A1A_LL1
Sacramento River upstream of Red Bluff	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Trinity River below Lewiston Reservoir	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
American River below Nimbus Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Stanislaus River below New Melones Dam	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 6 Alternative 1A would not cause a substantial reduction in spawning and juvenile and adult  
 7 Sacramento-San Joaquin roach rearing habitat. Flows under Alternative 1A in all rivers examined  
 8 throughout the year are generally similar to or greater than flows under the NAA, except during July  
 9 through September are generally lower in the Feather River high flow channel and in the American  
 10 River below Nimbus Dam, although these reductions would not be biologically meaningful to the  
 11 roach population. The percentage of months outside temperature thresholds are generally similar to

1 or lower under Alternative 1A than under NAA. In addition, Sacramento-San Joaquin roach occur  
2 primarily in tributary habitat areas, where there would be little or no effects from Alternative 1A  
3 water operations.

4 **CEQA Conclusion:** In general, Alternative 1A would reduce the quality and quantity of upstream  
5 habitat conditions for Sacramento-San Joaquin Roach relative to Existing Conditions.

#### 6 **Flows**

7 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
8 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
9 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
10 rearing. The Sacramento River and its large tributaries are most likely not the primary habitat of  
11 Sacramento-San Joaquin roach. It is more likely that they are washed into these bigger streams from  
12 smaller tributaries which would likely be warmer than the below dam releases that are made for  
13 salmonid fishes.

14 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
15 or greater than flows under Existing Conditions during all months but July through September and  
16 November, except in wet years during May (14% lower) (Appendix 11C, CALSIM II Model Results  
17 utilized in the Fish Analysis). Flows under A1A\_LLT during July through September and November  
18 would be lower than flows under Existing Conditions (up to 24% lower).

19 Sacramento-San Joaquin roach are not found in Trinity River screw trap data (Pinnix et al. 2010), or  
20 within the Klamath Province (Moyle 2002).

21 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
22 than flows under Existing Conditions throughout the year, except in critical years during August and  
23 September (17% and 38% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in  
24 the Fish Analysis).

25 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
26 those under Existing Conditions during February through June, October, and December (up to 204%  
27 greater), lower during July through September (up to 56% lower), and similar during November and  
28 January (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

29 In the American River at Nimbus Dam, flows under A1A\_LLT would generally greater than flows  
30 under Existing Conditions during February, March, and October (up to 42% greater), lower during  
31 January, May, July through September, and November through December (up to 53% lower), and  
32 generally similar during the rest of the year (Appendix 11C, CALSIM II Model Results utilized in the  
33 Fish Analysis).

34 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
35 covered fish species under Alternative 1A (see Impacts AQUA-76–through 78 under Chinook salmon  
36 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
37 flows during the period relative to Existing Conditions.

#### 38 **Water Temperature**

39 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
40 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
41 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced

1 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.  
2 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

3 Water temperatures would not exceed 86°F under Existing Conditions or A1A\_LLT in any of the  
4 waterways examined (Table 11-1A-98). As a result, there would be no difference in the percentage  
5 of months in which the 86°F water temperature threshold is exceeded between Alternative 1A and  
6 Existing Conditions.

7 Collectively, these results indicate that the impact would not be significant because Alternative 1A  
8 would cause a substantial reduction in Sacramento-San Joaquin roach spawning habitat or juvenile  
9 and adult rearing habitat, as these occur primarily in tributary habitat areas. However, flows would  
10 be substantially lower during the majority of the year-round juvenile and adult rearing period in the  
11 American River and in one third of the period in the Feather River. Flows in other rivers would not  
12 have biologically meaningful effects.

### 13 **Hardhead**

#### 14 ***Flows***

15 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
16 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
17 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
18 adult rearing.

19 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT during August, September, and  
20 November would be lower than flows under NAA (up to 44% lower), and generally similar to or  
21 greater than flows under NAA during the rest of the year, with some exceptions (up to 11% lower)  
22 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

23 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
24 Province (Moyle 2002).

25 In Clear Creek at Whiskeytown Dam). Flows under A1A\_LLT would generally be similar to or greater  
26 than NAA throughout the year, except in critical years during June and September (8% and 13%  
27 lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

28 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
29 those under NAA during October through June (up to 219% greater) and lower during July through  
30 September (up to 86% lower) (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

31 In the American River at Nimbus Dam, flows under A1A\_LLT would generally be greater than flows  
32 under NAA during May, June, and October (up to 37% greater), generally lower during July through  
33 September (up to 47% lower), and generally similar during the remaining months (Appendix 11C,  
34 CALSIM II Model Results utilized in the Fish Analysis).

35 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
36 covered fish species under Alternative 1A (see Impacts AQUA-76- through 78 under Chinook  
37 salmon fall-/late-fall run ESU). That analysis indicates that there would be no differences in flows  
38 relative to the NAA.

1       **Water Temperature**

2       The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for  
3       juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,  
4       and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat  
5       quality and increased stress and mortality. Water temperatures were not modeled in the San  
6       Joaquin River or Clear Creek.

7       In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
8       the range would be similar to or lower than the percentage under NAA in all water year types (Table  
9       11-1A-99).

10       Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
11       Province (Moyle 2002).

12       In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
13       the range would be lower than the percentage under NAA in all water year types except below  
14       normal years (6% higher) (Table 11-1A-99).

15       In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
16       59°F to 75°F water temperature range would be similar to or lower than the percentage under NAA  
17       in all water year types (Table 11-1A-99).

18       In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
19       the range would be similar to the percentage under NAA in all water year types (Table 11-1A-99).

1 **Table 11-1A-99. Difference and Percent Difference in the Percentage of Months in Which Year-**  
 2 **Round Water Temperatures Are outside the 65°F to 82.4°F Water Temperature Range for Juvenile**  
 3 **and Adult Hardhead Occurrence<sup>a</sup>**

Location	Water Year Type	EXISTING CONDITIONS	
		vs. A1A_LLT	NAA vs. A1A_LLT
Sacramento River upstream of Red Bluff	Wet	0 (0%)	0 (0%)
	Above Normal	-1 (-1%)	0 (0%)
	Below Normal	-1 (-1%)	-1 (-1%)
	Dry	-4 (-4%)	0 (0%)
	Critical	-14 (-15%)	-1 (-1%)
	All	-3 (-3%)	0 (0%)
Trinity River below Lewiston Reservoir	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	-1 (-1%)	0 (0%)
	Dry	-1 (-1%)	0 (0%)
	Critical	-9 (-9%)	-1 (-1%)
	All	-2 (-2%)	0 (0%)
Feather River below Thermalito Afterbay	Wet	-5 (-7%)	-2 (-3%)
	Above Normal	-9 (-13%)	-5 (-7%)
	Below Normal	-7 (-9%)	4 (6%)
	Dry	-7 (-10%)	0.5 (1%)
	Critical	-8 (-11%)	-1 (-1%)
	All	-7 (-9%)	-1 (-1%)
American River below Nimbus Dam	Wet	-20 (-25%)	1 (1%)
	Above Normal	-17 (-24%)	0 (0%)
	Below Normal	-17 (-24%)	1 (1%)
	Dry	-13 (-20%)	0 (-1%)
	Critical	-13 (-21%)	0 (0%)
	All	-17 (-23%)	0 (0%)
Stanislaus River below New Melones Dam	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
	Below Normal	0 (0%)	0 (0%)
	Dry	0 (0%)	0 (0%)
	Critical	-1 (-1%)	0 (0%)
	All	0 (0%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 6 Alternative 1A would not cause a substantial reduction in spawning and juvenile and adult hardhead  
 7 rearing. Flows under Alternative 1A in all rivers examined throughout the year are generally similar  
 8 to or greater than flows under the NAA, except during summer months in the Feather and half the  
 9 year in the American rivers. These reductions in flows, however, would not cause an overall  
 10 biologically meaningful effect on hardhead due to the high mobility and diverse distribution of  
 11 hardhead in the Central Valley. The percentages of years outside all temperature thresholds in all  
 12 locations examined under Alternative 1A are generally lower than under the NAA.

1 **CEQA Conclusion:** In general, Alternative 1A would reduce the quality and quantity of upstream  
2 habitat conditions for hardhead relative to Existing Conditions.

3 **Flows**

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
5 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
6 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
7 adult rearing.

8 In the Sacramento River upstream of Red Bluff, flows under A1A\_LLT would generally be similar to  
9 or greater than flows under Existing Conditions during all months but July through September and  
10 November, except in wet years during May (14% lower) (Appendix 11C, CALSIM II Model Results  
11 utilized in the Fish Analysis). Flows under A1A\_LLT during July through September and November  
12 would be lower than flows under Existing Conditions (up to 24% lower).

13 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
14 Province (Moyle 2002).

15 In Clear Creek at Whiskeytown Dam, flows under A1A\_LLT would generally be similar to or greater  
16 than flows under Existing Conditions throughout the year, except in critical years during August and  
17 September (17% and 38% lower, respectively) (Appendix 11C, CALSIM II Model Results utilized in  
18 the Fish Analysis).

19 In the Feather River at Thermalito Afterbay, flows under A1A\_LLT would generally be greater than  
20 those under Existing Conditions during February through June, October, and December (up to 204%  
21 greater), lower during July through September (up to 56% lower), and similar during November and  
22 January (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis).

23 In the American River at Nimbus Dam, flows under A1A\_LLT would generally greater than flows  
24 under Existing Conditions during February, March, and October (up to 42% greater), lower during  
25 January, May, July through September, and November through December (up to 53% lower), and  
26 generally similar during the rest of the year (Appendix 11C, CALSIM II Model Results utilized in the  
27 Fish Analysis).

28 Flow rates in the San Joaquin and Stanislaus rivers would be the same as described above for  
29 covered fish species under Alternative 1A (see Impacts AQUA-76 through 78 under Chinook salmon  
30 fall-/late-fall run ESU). That analysis indicates that there would be small to moderate reductions in  
31 flows during the period relative to Existing Conditions.

32 **Water Temperature**

33 The percentage of months in which year-round in-stream temperatures would be outside of the  
34 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was  
35 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures  
36 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.  
37 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

38 In the Sacramento River upstream of Red Bluff, the percentage of months under A1A\_LLT outside  
39 the range would be similar to or lower than the percentage under Existing Conditions in all water  
40 year types (Table 11-1A-99).

1 Hardhead are not found in Trinity River screw trap data (Pinnix et al. 2010), or within the Klamath  
2 Province (Moyle 2002).

3 In the Feather River below Thermalito Afterbay, the percentage of months under A1A\_LLT outside  
4 the range would be lower than the percentage under Existing Conditions in all water year types  
5 (Table 11-1A-99).

6 In the American River below Nimbus Dam, the percentage of months under A1A\_LLT outside the  
7 range would be lower than the percentage under Existing Conditions in all water year types (Table  
8 11-1A-99).

9 In the Stanislaus River below New Melones Dam, the percentage of months under A1A\_LLT outside  
10 the range would be similar to the percentage under Existing Conditions in all water year types  
11 (Table 11-1A-99).

12 Collectively, these results indicate that the impact would be significant because Alternative 1A  
13 would cause a substantial reduction in hardhead habitat. Flows would be substantially lower during  
14 the majority of the year-round juvenile and adult rearing period in the American River and in one  
15 third of the period in the Feather River. Flows in other rivers would not have biologically meaningful  
16 effects on hardhead. The percentages of years outside the temperature thresholds are generally  
17 lower under Alternative 1A than under Existing Conditions, except for the 59–64°F spawning  
18 temperature range in the American River. This impact is a result of the specific reservoir operations  
19 and resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
20 operations in order to alter the flows) to the extent necessary to reduce this impact to a less than  
21 significant level would fundamentally change the alternative, thereby making it a different  
22 alternative than that which has been modeled and analyzed. As a result, this impact is significant and  
23 unavoidable because there is no feasible mitigation available.

24 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
25 using two unique baselines. The NEPA conclusion was based on the comparison of A1A\_LLT with  
26 NAA and the CEQA conclusion was based on the comparison of A1A\_LLT with Existing Conditions.  
27 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
28 water years whereas the CEQA Existing Conditions do not. Second, the NAA is assumed to occur  
29 during the late long-term implementation period whereas the CEQA baseline is assumed to occur  
30 during existing climate conditions. Therefore, differences in model outputs between the CEQA  
31 baseline and the Alternative 1A are due primarily to both the alternative and future climate change.

### 32 **California Bay Shrimp**

33 **NEPA Effects:** For California bay shrimp the overall flows and temperature within the estuary would  
34 be neutral or slightly improved with respect to rearing. These conditions would not be adverse.

35 **CEQA Conclusion:** As described immediately above, the impacts of water operations on rearing  
36 conditions for California bay shrimp would not be significant and no mitigation is required.

1 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**  
2 **Aquatic Species of Primary Management Concern**

3 **Striped Bass**

4 **NEPA Effects:** Refer to Impact AQUA-6 under delta smelt and Impact AQUA-42 under Chinook  
5 salmon for a discussion of the effects of water operations on migration conditions for striped bass.  
6 The potential effects would be similar to those described there. The potential effects would be  
7 similar to those described, although the primary mechanisms of effect are likely to be changes in  
8 water flow, and related water temperatures, which could alter adult spawning migration timing. In  
9 addition, newly hatched larvae drift with the currents, so changes in flow would affect the rate of  
10 downstream movement, resulting in potential changes in food availability, predation rates, and  
11 available suitable habitat. The effects would not be adverse.

12 **CEQA Conclusion:** As described above the impacts on striped bass migration conditions would be  
13 less than significant.

14 **American Shad**

15 **NEPA Effects:** Refer to Impact AQUA-6 under delta smelt and Impact AQUA-42 under Chinook  
16 salmon for a discussion of the effects of water operations on migration conditions for American  
17 shad. The potential effects would be similar to those described there. The potential effects would be  
18 similar to those described, although the primary mechanism of effect would be changes in flow,  
19 which could affect adult and juvenile migration timing and migration rates. The effects would not be  
20 adverse.

21 **CEQA Conclusion:** As described above the impacts on American shad migration conditions would be  
22 less than significant.

23 **Threadfin Shad**

24 **NEPA Effects:** Threadfin shad are non-migratory fish within the Delta, so they do not use the Delta  
25 as migration habitat. Therefore, Alternative 1A would have no effect on their movements within the  
26 Delta.

27 **CEQA Conclusion:** As described above, threadfin shad are non-migratory, so flow changes under  
28 Alternative 1A would have no impact on their movements within the Delta. Therefore, no mitigation  
29 is required.

30 **Largemouth Bass**

31 **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use  
32 the Delta as migration habitat corridor. There would be no effect.

33 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 1A would not  
34 affect largemouth movements within the Delta. No mitigation would be required.

35 **Sacramento Tule Perch**

36 **NEPA Effects:** Similar with largemouth bass, Sacramento tule perch are a non-migratory species and  
37 do not use the Delta as a migration corridor as they are a resident Delta species. There would be no  
38 effect.

1 **CEQA Conclusion:** As described immediately above, flow movements would not affect Sacramento  
2 tule perch movements within the Delta. No mitigation would be required.

### 3 **Sacramento-San Joaquin Roach**

4 **NEPA Effects:** Sacramento-San Joaquin roach are non-migratory, and the overall flows and  
5 temperature in upstream rivers during spawning would be similar to those described under  
6 Alternative 1A, Impact AQUA-202 for spawning. As described there, the flows would slightly  
7 improve the upstream spawning conditions relative to the NAA, but would have no effect on  
8 Sacramento-San Joaquin roach movement in the Delta.

9 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
10 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

### 11 **Hardhead**

12 **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration  
13 to their spawning grounds would be similar to those described under Alternative 1A, Impact AQUA-  
14 202 for spawning. As described there, the flows would slightly improve the upstream conditions  
15 relative to the NAA. These conditions would not be adverse.

16 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
17 conditions for hardhead would not be significant and no mitigation is required.

### 18 **California Bay Shrimp**

19 **NEPA Effects:** For California bay shrimp the overall flows and temperature in the estuary associated  
20 with migration would be similar to those described under Alternative 1A, Impact AQUA-202 for  
21 spawning. As described there, the flows would not be adverse.

22 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
23 conditions for California bay shrimp would not be significant and no mitigation is required.

### 24 **Restoration Measures (Conservations Measures 2, 4–7, and 10)**

25 The effects of restoration measures under Alternative 1A would be similar for all non-covered  
26 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by  
27 individual species.

### 28 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic 29 Species of Primary Management Concern**

30 **NEPA Effects:** Refer to Impact AQUA-7 under delta smelt a discussion of the effects of construction  
31 of restoration measures on non-covered species of primary management concern. The potential  
32 effects would be similar to those described there. These effects would not be adverse.

33 **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration  
34 measures would be less than significant.

1 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**  
2 **Covered Aquatic Species of Primary Management Concern**

3 *NEPA Effects:* Refer to Impact AQUA-8 under delta smelt a discussion of the effects of contaminants  
4 associated with restoration measures on non-covered species of primary management concern. The  
5 potential effects would be similar to those described there. These effects would not be adverse.

6 *CEQA Conclusion:* As described immediately above, the impacts of contaminants associated with  
7 restoration measures would be less than significant.

8 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**  
9 **Primary Management Concern**

10 *NEPA Effects:* Refer to Impact AQUA-9 under delta smelt a general discussion of the effects of  
11 restored habitat conditions on non-covered species of primary management concern. Although  
12 there are minor differences the effects are similar including for food production and export. Striped  
13 bass use Suisun Bay and the lower San Joaquin River so restored habitat in those locations would be  
14 of direct benefit. Largemouth bass do not use the Yolo Bypass and that restored habitat would have  
15 no direct benefit for them. Sacramento-San Joaquin roach do not use Yolo Bypass or the main river  
16 channels so those habitat improvements would not benefit them. Hardhead are primarily upstream  
17 of the Delta or in the lowermost main tributary channels so habitat improvements would have  
18 minimal benefit for them. Similarly, Sacramento perch would mainly benefit from restoration of  
19 tidal marsh habitat which would increase food resources. Threadfin shad use the estuarine zone so  
20 the increased acreage and improved quality of estuarine habitat would benefit them. California bay  
21 shrimp use the estuarine zone within Suisun Marsh so the increased acreage and improved quality  
22 of habitat would benefit them. Downstream transport of food resources into the Bay would also  
23 benefit California bay shrimp.

24 *CEQA Conclusion:* As described immediately above, the impacts of restored habitat conditions  
25 would range from no impact, to slightly beneficial, to beneficial.

26 **Other Conservation Measures (CM12–CM19 and CM21)**

27 The effects of other conservation measures under Alternative 1A would be similar for all non-  
28 covered species; therefore, the analysis below is combined for all non-covered species instead of  
29 analyzed by individual species.

30 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**  
31 **Primary Management Concern (CM12)**

32 *NEPA Effects:* Refer to Impact AQUA-10 under delta smelt a discussion of the effects of  
33 methylmercury management on non-covered species of primary management concern The potential  
34 effects would be similar to those described there. These effects would not be adverse.

35 *CEQA Conclusion:* As described immediately above, the impacts of methylmercury management  
36 would be less than significant.

1 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**  
2 **Aquatic Species of Primary Management Concern (CM13)**

3 **NEPA Effects:** Refer to Impact AQUA-11 under delta smelt a discussion of the effects of invasive  
4 aquatic vegetation management on non-covered species of primary management concern. There are  
5 minor differences and the effects are similar except for predatory species (striped bass and  
6 largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides staging habitat  
7 for predatory fish at intermediate abundance which improves their hunting success. Sacramento  
8 tule perch also use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in  
9 Suisun marsh. Consequently, reducing large amounts of invasive aquatic habitat will lower  
10 predatory species hunting success rates and provide less cover for Sacramento tule perch. However,  
11 this control will not substantially reduce places for predatory species to hunt and there will still be  
12 many other habitats in which the predatory species can successfully hunt and in which Sacramento  
13 tule perch would find shelter from predators. The effect on them will not be adverse. Control of  
14 invasive aquatic vegetation would not occur within California bay shrimp habitat and there would  
15 be no effect on them.

16 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt a discussion of the effects of invasive  
17 aquatic vegetation management on non-covered species of primary management concern. There are  
18 minor differences and the effects are similar except for predatory species, California bay shrimp and  
19 Sacramento tule perch. Invasive aquatic vegetation provides staging habitat for predatory fish which  
20 improves their hunting success. Control of invasive aquatic vegetation would not occur within  
21 California bay shrimp habitat and there would be no effect on them. Sacramento tule perch also use  
22 the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh.  
23 Consequently, reducing the amount of invasive aquatic habitat will lower predatory species hunting  
24 success rates and provide less cover for Sacramento tule perch. However, this control will not  
25 substantially reduce places for predatory species to hunt and there will still be many other habitats  
26 in which Sacramento tule perch would find shelter from predators. Therefore the effect on them will  
27 not be significant and no mitigation is required.

28 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**  
29 **Species of Primary Management Concern (CM14)**

30 **NEPA Effects:** Refer to Impact AQUA-12 under delta smelt a discussion of the effects of dissolved  
31 oxygen level management on non-covered species of primary management concern. The potential  
32 effects would be similar to those described there. California bay shrimp do not occur in this habitat  
33 and there would be no effect on them. These effects would be beneficial.

34 **CEQA Conclusion:** As described immediately above, the impacts of oxygen level management would  
35 be beneficial.

36 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**  
37 **Species of Primary Management Concern (CM15)**

38 **NEPA Effects:** Refer to Impact AQUA-13 under delta smelt a discussion of the effects of predatory  
39 fish (striped bass and largemouth bass) and predator management on non-predatory fish. The  
40 purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce  
41 their hunting success. To the extent that localized predator control efforts of *CM15 Localized*  
42 *Reduction of Predatory Fish* reduce the overall abundance of fish predators in the Delta, this  
43 management will have negative effects on predatory fish. However, the numbers of predatory fish

1 are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of this  
2 management will not be adverse. California bay shrimp do not occur in these habitats and there  
3 would be no effect on them.

4 **CEQA Conclusion:** Refer to Impact AQUA-13 under delta smelt a discussion of the effects of  
5 predatory fish and predator management on non-predatory fish. The purpose of predatory fish  
6 management is to reduce the numbers of predatory fish and to reduce their hunting success. To the  
7 extent that localized predator control efforts of *CM15 Localized Reduction of Predatory Fish* reduce  
8 the overall abundance of fish predators in the Delta, this management will have negative effects on  
9 predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in  
10 which they hunt is extensive. Therefore the effects of this management will not be significant. No  
11 mitigation is required. California bay shrimp do not occur in these habitats and there would be no  
12 effect on them.

13 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**  
14 **Primary Management Concern (CM16)**

15 **NEPA Effects:** Refer to Impact AQUA-14 under delta smelt a discussion of the effects of nonphysical  
16 fish barriers on non-covered species of primary management concern. Although there are minor  
17 differences the effects are similar except for Sacramento-San Joaquin roach, hardhead, and  
18 Sacramento perch which are unlikely to be present in their vicinity. California bay shrimp do not  
19 occur in these habitats and there would be no effect on them. The effects would not be adverse.

20 **CEQA Conclusion:** As described immediately above, the impacts of nonphysical fish barriers would  
21 be less than significant.

22 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**  
23 **Primary Management Concern (CM17)**

24 **NEPA Effects:** Refer to Impact AQUA-15 under delta smelt a discussion of the effects of illegal  
25 harvest reduction on non-covered species of primary management concern. The potential effects  
26 would be similar to those described there. California bay shrimp do not occur in these habitats and  
27 there would be no effect on them. The effects would not be adverse.

28 **CEQA Conclusion:** As described immediately above, the impacts of illegal harvest reduction would  
29 be less than significant.

30 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**  
31 **Primary Management Concern (CM18)**

32 **NEPA Effects:** Refer to Impact AQUA-16 under delta smelt a discussion of the effects of conservation  
33 hatcheries on non-covered species of primary management concern. There would be no effect.

34 **CEQA Conclusion:** As described immediately above, conservation hatcheries would have not impact.

35 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**  
36 **of Primary Management Concern (CM19)**

37 **NEPA Effects:** Refer to Impact AQUA-17 under delta smelt a discussion of the effects of urban  
38 stormwater treatment on non-covered species of primary management concern. These effects  
39 would be beneficial.

1 **CEQA Conclusion:** As described immediately above, the impacts of stormwater management would  
2 be beneficial.

3 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
4 **Aquatic Species of Primary Management Concern (CM21)**

5 **NEPA Effects:** Refer to Impact AQUA-18 under delta smelt a discussion of the effects of  
6 removal/relocation of nonproject diversion on non-covered species of primary management  
7 concern. Although there are minor differences the effects are similar except for Sacramento-San  
8 Joaquin roach, hardhead, and Sacramento perch which are unlikely to be present near these  
9 diversions. California bay shrimp do not occur in these habitats and there would be no effect on  
10 them. The effects would not be adverse.

11 **CEQA Conclusion:** As described immediately above, the impacts of removal/relocation of nonproject  
12 diversions would be less than significant.

13 **Upstream Reservoirs**

14 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

15 As previously described under the methods for the reservoir coldwater fish habitat analysis (Section  
16 11.3.2.7), Shasta Reservoir was analyzed first and that approach was then applied, in combination  
17 with CALSIM modeling and the selected minimum coldwater habitat volumes, to evaluate the effects  
18 of the alternatives on coldwater habitat for the other major CVP and SWP reservoirs.

19 The evaluation of the Shasta Reservoir coldwater habitat volume can be described in three basic  
20 steps: 1) describe the reservoir geometry (volume and surface area) as a function of elevation, 2)  
21 describe the seasonal (monthly) water temperatures as a function of the elevation, storage level and  
22 outlet elevation(s), and 3) determine the portion of the reservoir volume with temperatures less  
23 than 60°F for the full range of carryover storages simulated with CALSIM. The coldwater habitat  
24 assessment compares the number of years with carryover storage less than the selected minimum  
25 volume index corresponding to the minimum acceptable coldwater habitat volume between the  
26 NAA and the BDCP alternatives, for each reservoir.

27 The reservoir geometry (surface area and volume) as a function of the water elevation and the  
28 elevation of the reservoir outlets are the basic features that determine the coldwater habitat in each  
29 reservoir. Table 11-1A-100 gives a summary of the Shasta Reservoir area (acres) and volume (acre-  
30 feet) for 25-foot increments of elevation. Figure 11-1A-6 shows the Shasta Reservoir volume  
31 (thousand acre-feet [taf]) as a function of elevation. The bottom of Shasta Reservoir is at 630 feet  
32 msl, but there is very little storage volume (50 taf) below an elevation of 700 ft. The maximum  
33 elevation of about 1,065 corresponds to a maximum storage of about 4,550 taf. Figure 11-1A-6  
34 shows the Shasta Reservoir surface area (acres) as a function of elevation. The bottom sediment  
35 area (where benthic food organisms live) is about the same as the water surface area (where  
36 photosynthesis and heat exchange occurs).

37 The elevations of the reservoir outlets are also important for understanding the coldwater pool. The  
38 coldest water at the bottom of the reservoir (below the outlet penstocks to the hydropower  
39 turbines) remains at nearly the same temperature during the stratified period. Shasta Dam has river  
40 outlets with gate sills (bottoms) located at elevation 742 feet and 942 feet (the river gate at 842 feet  
41 is no longer operational). The gates are about 8 feet high, so water comes from a zone approximately

1 20 feet high centered at about 750 feet and 950 feet (when they are used). The intakes for the 15-  
 2 feet diameter penstocks to the hydropower turbines are located with a centerline elevation of 815  
 3 feet, so water is drawn from elevations of approximately 800 feet to 830 feet. The spillway crest  
 4 elevation is at 1,037 feet. During the 1976–1977 and the 1987–1992 drought periods, when Shasta  
 5 Reservoir storage was low and water temperatures released through the hydropower plant were  
 6 greater than 55°F, the low-level river outlets (at 750 feet and 850 feet) were used to blend with the  
 7 hydropower releases (from 800–830 feet) to provide cooler release temperatures at Keswick Dam  
 8 for winter run spawning and egg incubation. Subsequently, to protect winter-run spawning and egg  
 9 incubation temperatures and also make full hydropower releases, the temperature control device  
 10 (TCD) was designed and constructed. The TCD, which began operating in 1998, allows all releases to  
 11 be made through the hydropower penstocks. Three levels of louver “gates” allow the penstock water  
 12 to be blended from three elevation zones. Higher level releases are used early in the summer to  
 13 preserve as much of the cold water as possible; the open gate levels are adjusted towards the  
 14 bottom gate during the summer. By preserving the coldest water for the early fall period (September  
 15 and October), the cold water habitat in the reservoir is also protected through the summer months;  
 16 however, use of the low level gate allows more of the cold water from the bottom of the reservoir to  
 17 be released in September and October. Table 11-1A-100 indicates that the storage volume located  
 18 below the penstocks (800 feet) is about 350 taf with a benthic area within this protected cold water  
 19 habitat of about 5,000 acres.

20 **Table 11-1A-100. Shasta Reservoir Geometry**

Elevation (feet)	Surface Area (acres)	Volume (acre-feet)
1,075	30,908	4,792,000
1,050	27,654	4,068,649
1,025	24,633	3,388,333
1,000	21,800	2,830,000
975	19,200	2,345,000
950	16,600	1,860,000
925	14,300	1,505,000
900	12,000	1,150,000
875	10,100	907,500
850	8,200	665,000
825	6,617	490,624
800	5,080	342,000
775	3,800	233,333
750	2,800	150,000
725	1,914	85,714
700	1,200	50,000
675	771	18,750
650	343	3,437

21  
 22 The seasonal (monthly) reservoir release temperature and the vertical temperature profiles within  
 23 the reservoir are directly linked and depend on the elevation of the outlets and the reservoir  
 24 geometry and water surface elevation. The relationships between carryover storage and release  
 25 temperatures for the major CVP and SWP reservoirs are shown and described in Appendix 29C

1 “Climate Change and Effects of Reservoir Operations on Water Temperatures.” Release  
2 temperatures are relatively cool and stable until the fall months. The release temperatures increase  
3 and the remaining coldwater habitat volume decreases as the carryover reservoir storage is reduced  
4 in dry years. Only if the carryover storage is reduced below a specific volume (taf) are the release  
5 temperatures moderately increased. For storages below this threshold, the release temperature  
6 increases as the storage is reduced and the coldwater habitat volume is substantially reduced.

7 The cold water habitat of a reservoir is located below the vertical temperature gradient that  
8 develops in the spring months of April-June. Figure 11-1A-7 illustrates the seasonal development of  
9 surface warming and temperature stratification in Shasta Reservoir, and the fall cooling of surface  
10 temperatures in the fall and early winter months during 1995. These data were collected just  
11 upstream of Shasta Dam at depths corresponding to elevations of 650 feet to the surface in 25-foot  
12 increments. The water temperatures were never quite fully- mixed and isothermal (same  
13 temperatures) in 1995. The temperatures at the end of January and the end of February were about  
14 45<sup>0</sup>F at the bottom and 50<sup>0</sup>F at the top (water surface elevation of 1,025 feet). Surface temperatures  
15 were less than 55<sup>0</sup>F at the end of March and April, but increased to 65<sup>0</sup>F at the end of May and June.  
16 The warmest surface temperatures (80<sup>0</sup>F) were measured at the end of July, with slightly cooler  
17 surface temperatures of 75<sup>0</sup>F at the end of August and September. At the end of October the surface  
18 temperatures were less than 65<sup>0</sup>F and the surface cooling had caused the water to mix (isothermal)  
19 to a depth of about 100 feet. By the end of December the surface temperatures were less than 60<sup>0</sup>F  
20 and the surface mixed layer had a depth of about 150 feet.

21 Warming of the reservoir below the surface heated layer is caused by water releases from the  
22 outlets; warmer water from above is drawn down to replace the water released from the penstock  
23 (elevation 800 feet) or the low-level river outlet (elevation 750 feet). The warming may also depend  
24 on the reservoir inflow and outflow during these summer months. Inflowing water will usually be  
25 cooler than the surface temperature and will enter the reservoir profile at the matching  
26 temperature; this will expand the depth of this temperature layer. The effects of inflowing water can  
27 be stronger during the fall, when the cooler inflow contributes to the deepening of the surface mixed  
28 layer.

29 The effects of reservoir storage drawdown on the coldwater habitat volume can be tracked by  
30 evaluating the coldwater habitat volume available through the year. Figure 11-1A-7 shows the  
31 entire reservoir was coldwater habitat (<60<sup>0</sup>F) from January through April. The surface layer was  
32 warmer than 60<sup>0</sup>F in the summer months, but the reservoir volume below elevation 900 feet was  
33 less than 60<sup>0</sup>F at the end of September and the volume below elevation 875 feet was less than 60<sup>0</sup>F  
34 at the end of October. The minimum Shasta Reservoir storage at the end of September 1995 was  
35 about 3,400 taf (1,025 feet). The coldwater habitat volume would likely be more limited in years  
36 with a lower carryover storage volume. The end-of-September storage simulated with the CALSIM  
37 reservoir operation model will be used as the annual index for assessing coldwater habitat volume.  
38 A relationship between end of September storage and coldwater habitat volume was determined  
39 from the temperature profiles simulated with the Sacramento River Water Quality Model (SRWQM)  
40 developed for Reclamation by RMA. This model was used for each of the alternatives to simulate  
41 reservoir temperatures, release temperatures and downstream river temperatures. The model  
42 predicts reservoir profiles that were used to develop carryover storage-cold water habitat  
43 relationship for Shasta Reservoir.

44 Figure 11-1A-8 shows an example of the simulated relationship between reservoir storage and  
45 coldwater habitat (defined as less than 58<sup>0</sup>F in this example) for the No Action Baseline for 1922 to

1 2003. August was used in this example because September temperatures were not available in the  
2 coldwater habitat results. The SRWQM results show a strong relationship between August storage  
3 and coldwater habitat volume. The maximum coldwater habitat volume in August was about 1,500  
4 taf (below elevation 925 feet) for <58°F. The coldwater habitat volumes were reduced when the  
5 August storage volume was less than about 3,000 taf (below elevation 1,000 feet). Figure 11-1A-9  
6 shows the SRWQM-simulated relationship between Shasta Reservoir volume and coldwater habitat  
7 volume for the end of August. The relationship between Shasta Reservoir storage and coldwater  
8 habitat volume can be used to assess the effects of reduced end-of-year storage on coldwater habitat  
9 volume.

10 The evaluation of the annual carryover storage effects on coldwater habitat volumes can be made  
11 using either a specified “threshold” for coldwater habitat impact for each reservoir, or using a  
12 “scale” for coldwater habitat effects that would vary with carryover volume for each reservoir.  
13 Impacts could then be measured as the increase in the number of years with storage below the  
14 selected threshold value, or as the reduction in the average coldwater habitat effects calculated from  
15 a baseline carryover storage sequence to an alternative sequence of carryover storage values.  
16 However, because a rating scale will provide the average coldwater habitat benefits rather than  
17 emphasizing the poor conditions in the lower storage years, large impacts in a few years will be  
18 masked by the generally suitable conditions. For this reason, the threshold storage method is  
19 preferred for impact evaluation. The impact evaluation of Shasta Reservoir operations on coldwater  
20 habitat volume was based on a specified threshold storage that would protect sufficient coldwater  
21 habitat volume for the fish populations in the reservoir.

22 Figure 11-1A-9 can be used as the basis for a specified threshold volume or for a specified “scaling”  
23 of carryover storage coldwater benefits. Assuming 60°F as the upper limit for coldwater habitat,  
24 carryover storage of about 3,500 taf (maximum end-of September Shasta storage) would provide a  
25 coldwater habitat volume of 1,500 taf. Carryover storage of 2,500 taf would provide a coldwater  
26 habitat volume of about 750 taf, which is about half of the maximum coldwater habitat volume of  
27 1,500 taf. Carryover storage of 2,000 taf would provide a coldwater habitat volume of about 500 taf,  
28 which is about 33% of the maximum coldwater habitat volume. Carryover storage of 1,500 taf would  
29 provide a coldwater habitat volume of about 250 taf, which is about 15% of the maximum coldwater  
30 habitat volume. Carryover storage of 1,000 taf would provide a coldwater habitat volume of about  
31 50 taf, which is less than 5% of the maximum coldwater habitat volume. Because the minimum  
32 coldwater volume needed to protect the coldwater fish population in Shasta Reservoir is not known,  
33 the assessments for three carryover storage thresholds (2,500 taf, 2,000 taf, and 1,500 taf) were  
34 compared. Table 11-1A-101 shows the summary of the Shasta Reservoir coldwater habitat for three  
35 possible threshold values. The number of years with carryover storage less than the selected  
36 threshold (indicating a substantial reduction in coldwater habitat) for each alternative was  
37 compared to the number of years below the threshold storage for the baseline. As the carryover  
38 storage threshold is reduced, the likely impacts on coldwater habitat will be greater, but the impacts  
39 will be less frequent (measured as the number of years with carryover storage below the threshold).  
40 A coldwater habitat adverse effect determination was based on the number of additional years with  
41 carryover storage below the specified threshold value. An increase of greater than 5% of the years  
42 (5 more years) was selected as a substantial change in coldwater habitat conditions because these  
43 low storage conditions are expected infrequently during multi-year dry periods.

1 A comparison of the baseline cases shows the expected impacts on coldwater habitat from the  
 2 effects of climate change shifts in hydrology as well as operational changes related to the Fall X2  
 3 requirements (USFWS BO) compared to the previous D-1641 Delta outflow criteria. The Shasta  
 4 Reservoir carryover storage for the Existing Conditions baseline with no Fall X2 requirement  
 5 (Existing Conditions) was less than 2,500 taf in 19 years, was less than 2,000 taf in 13 years and was  
 6 less than 1,500 taf in 9 years (out of 82 years). The Shasta Reservoir carryover storage for the No  
 7 Action Alternative (NAA) was less than 2,500 taf in 44 years, was less than 2,000 taf in 22 years and  
 8 was less than 1,500 taf in 15 years. The increases for all of the storage thresholds would be judged  
 9 adverse because an increase of greater than 5% of the years (5) was selected as the significance  
 10 criteria. About 20–25% of the baseline carryover storage values should be less than the selected  
 11 storage threshold, so that the threshold represents the lowest 20–25% of the years and so that the  
 12 number of years with these impacted coldwater habitat conditions could be increased if the  
 13 carryover storage values were reduced substantially by an alternative. The Shasta carryover storage  
 14 threshold was selected to be 2,000 taf; the storage was less than this threshold in about 27% of the  
 15 years (22/82) for the NAA.

16 Table 11-1A-101 indicates that using the 2,000 taf carryover storage threshold with a greater than  
 17 5% (5 year) increase criteria, none of the alternatives, including Alternative 1A, would have an  
 18 adverse effect on Shasta Reservoir coldwater habitat in the late-long-term (LLT) when compared to  
 19 the NAA. All of the alternatives would have Shasta Reservoir carryover storages of less than 2,000  
 20 taf in about the same number of years (19–23) as the baseline (22).

21 ***Evaluation of Effects on Coldwater Habitat in Other CVP and SWP Reservoirs***

22 It is generally assumed that the availability of cold water can affect the success or sustainability of  
 23 reservoir fish populations but specific management or biological criteria for defining this  
 24 relationship for the major CVP and SWP reservoirs are not available. Based on the rationale  
 25 presented above for Shasta Reservoir, carryover storage thresholds for each of the CVP and SWP  
 26 reservoirs have been selected for this analysis for coldwater habitat conditions.

27 Table 11-1A-10 shows the summary of coldwater habitat evaluations for each of the six major CVP  
 28 and SWP reservoirs. A single carryover storage threshold value was selected for each reservoir.  
 29 Following the Shasta Reservoir example, this was based on a combination of available temperature  
 30 profiles, hydropower penstock elevations, and minimum simulated storage values for each  
 31 reservoir. Threshold carryover storage values were selected for each reservoir so that about 20–  
 32 25% of the baseline carryover storage values would be less than the storage threshold; and  
 33 assuming that greater than 5% more years (5 years) with less than the threshold storage would be  
 34 an adverse effect on coldwater habitat conditions for each reservoir as a result of substantially less  
 35 coldwater habitat being available during those years.

36 Trinity Reservoir has a maximum storage of about 2,500 taf and maximum carryover storage of  
 37 1,975 taf. The minimum simulated storage was about 250 taf, corresponding to the hydropower  
 38 penstock intake. About 20% of CALSIM-simulated Trinity Reservoir carryover storages for the NAA  
 39 baseline were less than 750 taf. The Trinity River Restoration Agreement required minimum  
 40 carryover storages of 600 taf, and the 2009 NMFS BO requires “consultation” with Reclamation if the  
 41 Trinity Reservoir carryover storage is expected to be less than 400 taf. The Trinity Reservoir  
 42 carryover storage threshold was selected to be 750 taf, with a greater than 5% increase (5 years)  
 43 impact criteria. Table 11-1A-102 indicates that none of the BDCP alternatives have adverse effects  
 44 on the Trinity Reservoir coldwater habitat conditions. Figure 11-1A-10 shows the Trinity Reservoir

1 carryover storages for the BDCP Alternatives (LLT) compared to the NAA carryover storages for  
2 1922–2003. This provides a graphical description of the similarity of the Trinity Reservoir carryover  
3 storage sequences simulated with the CALSIM model for 1922–2003.

4 Shasta Reservoir has a maximum storage of about 4,500 taf and maximum carryover storage - of  
5 3,400 taf. The minimum simulated storage is about 550 taf, corresponding to the hydropower  
6 penstock intake. About 27% of CALSIM-simulated Shasta Reservoir carryover storage for the NAA  
7 was below 2,000 taf. The 2009 NMFS BO requires “consultation” with Reclamation if the Shasta  
8 Reservoir carryover storage is expected to be less than 1,900 taf. The Shasta Reservoir carryover  
9 storage threshold was selected to be 2,000 taf, with a greater than 5% increase (5 years) impact  
10 criteria. Table 11-1A-102 indicates that none of the BDCP alternatives have adverse effects on the  
11 Shasta Reservoir coldwater habitat conditions. Figure 11-1A-11 shows the Shasta Reservoir  
12 carryover storages for the Alternatives (LLT) compared to the NAA carryover storages for 1922–  
13 2003. This provides a graphical description of the similarity of the Shasta Reservoir carryover  
14 storage sequences simulated with the CALSIM model for 1922–2003.

15 Oroville Reservoir has a maximum storage of about 3,500 taf and maximum carryover storage of  
16 3,350 taf. The minimum simulated storage was about 500 taf, corresponding to the hydropower  
17 penstock intake. The 28% cumulative distribution of CALSIM-simulated Oroville Reservoir  
18 carryover storage for the NAA was about 1,000 taf. The Oroville target carryover storage is 1,000  
19 taf; SWP deliveries are adjusted to maintain this minimum operational storage. The Oroville  
20 Reservoir carryover storage threshold was selected to be 1,000 taf, with a greater than 5% increase  
21 (5 years) impact criteria. Table 11-1A-102 indicates that none of the alternatives have adverse  
22 effects on the Oroville Reservoir coldwater habitat conditions. Figure 11-1A-12 shows the Oroville  
23 Reservoir carryover storages for the Alternatives (LLT) compared to the NAA carryover storages for  
24 1922–2003. This provides a graphical description of the similarity of the Oroville Reservoir  
25 carryover storage sequences simulated with the CALSIM model for 1922–2003. Most of the  
26 alternatives would increase the carryover storage in Oroville Reservoir compared to the NAA;  
27 benefits for coldwater fish habitat in Oroville Reservoir are therefore expected for most alternatives.

28 Folsom Reservoir has a maximum storage of about 1,000 taf and maximum carryover storage of 650  
29 taf. The minimum simulated storage is about 100 taf, corresponding to the hydropower penstock  
30 intake. The 18% cumulative distribution of CALSIM-simulated Folsom Reservoir carryover storage  
31 for the NAA was about 250 taf. The 2009 NMFS BO requires “consultation” with Reclamation if the  
32 Folsom Reservoir carryover storage is expected to be less than 250 taf. The Folsom Reservoir  
33 carryover storage threshold was selected to be 250 taf, with a greater than 5% increase (5 years)  
34 impact criteria. Table 11-1A-102 indicates that some of the alternatives may have adverse effects on  
35 the Folsom Reservoir coldwater habitat conditions. Figure 11-1A-13 shows the Folsom Reservoir  
36 carryover storages for the Alternatives (LLT) compared to the NAA carryover storages for 1922–  
37 2003. This provides a graphical description of the similarity of the Folsom Reservoir carryover  
38 storage sequences simulated with the CALSIM model for 1922–2003. Because Folsom Reservoir  
39 maximum storage is only 1,000 taf and the carryover storage is relatively low most years, there is  
40 not a major coldwater fish population (trout) in Folsom Reservoir; the potential impacts on  
41 coldwater habitat in Folsom Reservoir are somewhat less than for coldwater habitat in Trinity,  
42 Shasta, and Oroville Reservoirs.

1 New Melones Reservoir has a maximum storage of about 2,400 taf and maximum carryover storage  
2 of 2,000 taf. The minimum simulated storage is about 100 taf, corresponding to the hydropower  
3 penstock intake. About 26% of CALSIM-simulated New Melones Reservoir carryover storage for the  
4 NAA were less than 750 taf. The New Melones Reservoir carryover storage threshold was selected to  
5 be 750 taf, with a greater than 5% increase (5 years) impact criteria. Table 11-1A-102 indicates that  
6 none of the alternatives have adverse effects on the New Melones Reservoir coldwater habitat  
7 conditions. Figure 11-1A-14 shows the New Melones Reservoir carryover storages for the  
8 Alternatives (LLT) compared to the NAA baseline carryover storages for 1922–2003. This provides a  
9 graphical description of the similarity of the New Melones Reservoir carryover storage sequences  
10 simulated with the CALSIM model for 1922–2003. Because the New Melones Reservoir (and all  
11 other San Joaquin Basin Reservoirs) operations were only changed for the climate change  
12 hydrology, there were no simulated differences in the New Melones Reservoir operations for the  
13 alternatives. There were, therefore, no impacts on New Melones Reservoir coldwater habitat  
14 conditions.

15 San Luis Reservoir has a maximum storage of about 2,000 taf and maximum carryover storage of  
16 1,725 taf. The minimum simulated storage is about 100 taf, corresponding to the hydropower  
17 penstock intake. About 26% of CALSIM-simulated San Luis Reservoir carryover storage for the NAA  
18 were less than 350 taf. The San Luis Reservoir carryover storage threshold was selected to be 350  
19 taf, with a greater than 5% increase (5 years) impact criteria. Figure 11-1A-15 shows the San Luis  
20 Reservoir carryover storages for the Alternatives (LLT) compared to the NAA carryover storages for  
21 1922–2003. This provides a graphical description of the differences in the San Luis Reservoir  
22 carryover storage sequences simulated with the CALSIM model for 1922–2003. Table 11-1A-102  
23 indicates that several of the alternatives will reduce the San Luis carryover storage substantially,  
24 with more than 4 additional years with carryover storage of less than 350 taf. However, because San  
25 Luis Reservoir is an off-stream storage reservoir that is filled each year with water exported from  
26 the Delta, the temperature stratification in the reservoir is usually eliminated by the pumping of  
27 relatively warm water into the reservoir through the inlet that is located near the bottom of the  
28 reservoir. The releases from San Luis Reservoir are also made through the intake/outlet structure  
29 near the bottom of the reservoir so that the coldest water is released during the spring and summer.  
30 Therefore, there is no coldwater habitat in the reservoir; San Luis Reservoir is dominated by warm-  
31 water fish (largemouth bass and striped bass). Although the San Luis Reservoir carryover storage  
32 was reduced by most of the alternatives, there is no coldwater habitat in San Luis Reservoir during  
33 most years and therefore no impacts to the coldwater habitat.

34 **NEPA Effects:** In summary, this effect would not be adverse because coldwater fish habitat in the  
35 CVP and SWP upstream reservoirs under Alternative 1A would not be substantially reduced when  
36 compared to the No Action Alternative.

37 **CEQA Conclusion:** In general, Alternative 1A would reduce the quantity of coldwater fish habitat in  
38 the CVP and SWP as shown in Table 11-1A-102. There would be a greater than 5% increase (5  
39 years) for several of the reservoirs when compared to Existing Conditions, which could result in a  
40 significant impact.

41 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
42 change, future water demands, and implementation of the alternative. The analysis described above  
43 comparing Existing Conditions to Alternative 1A does not partition the effect of implementation of  
44 the alternative from those of sea level rise, climate change and future water demands using the  
45 model simulation results presented in this chapter. However, the increment of change attributable

1 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
 2 be not adverse. As a result, the CEQA conclusion regarding Alternative 1A, if adjusted to exclude sea  
 3 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
 4 result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be  
 5 less than significant and no mitigation is required.

6 **Table 11-1A-101. Evaluation of Coldwater Habitat Impacts for Shasta Reservoir Using Three**  
 7 **Different Carryover Storage Thresholds (Years with Carryover Storage Less than Threshold, out of**  
 8 **82 Years)**

Reservoir Threshold	Shasta <2,500	Shasta <2,000	Shasta <1,500
<b>Baselines</b>			
Existing Conditions	19	13	9
NAA	44	22	15
<b>Alternatives</b>			
Alt 1 LLT	44	23	16
Alt 2 LLT	48	22	14
Alt 3 LLT	44	20	15
Alt 4 LLT	49	23	14
Alt 5 LLT	51	22	14
Alt 6 LLT	35	19	14
Alt 7 LLT	43	22	16
Alt 8 LLT	41	22	12
Alt 9 LLT	43	23	14

1 **Table 11-1A-102. Evaluation of Coldwater Habitat Effects (Years with Carryover Storage Less than Threshold) for CALSIM-Simulated Baselines**  
2 **and Alternatives for 1922–2003**

Reservoir	Trinity		Shasta		Oroville		Folsom		New Melones		San Luis	
Threshold (taf)	<750		<2,000		<1,000		<2,50		<7,50		<350	
Existing	11	13%	13	16%	8	10%	5	6%	17	21%	9	11%
NAA	16	20%	22	27%	23	28%	15	18%	21	26%	21	26%
	Value	Difference	Value	Difference	Value	Difference	Value	Difference	Value	Difference	Value	Difference
Existing v. Alt 1 LLT	19	8	23	10	8	0	15	10	21	4	23	14
NAA v. Alt 1 LLT	19	3	23	1	8	-15	15	0	21	0	23	2
Existing v. Alt 2 LLT	19	8	22	9	14	6	20	15	21	4	45	36
NAA v. Alt 2 LLT	19	3	22	0	14	-9	20	5	21	0	45	24
Existing v. Alt 3 LLT	18	7	20	7	8	0	15	10	21	4	25	16
NAA v. Alt 3 LLT	18	2	20	-2	8	-15	15	0	21	0	25	4
Existing v. Alt 4 LLT	18	7	23	10	14	6	19	14	21	4	51	42
NAA v. Alt 4 LLT	18	2	23	1	14	-9	19	4	21	0	51	30
Existing v. Alt 5 LLT	18	7	22	9	14	6	18	13	21	4	37	28
NAA v. Alt 5 LLT	18	2	22	0	14	-9	18	3	21	0	37	16
Existing v. Alt 6 LLT	16	5	19	6	6	-2	14	9	21	4	70	61
NAA v. Alt 6 LLT	16	0	19	-3	6	-17	14	-1	21	0	70	49
Existing v. Alt 7 LLT	17	6	22	9	8	0	19	14	21	4	63	54
NAA v. Alt 7 LLT	17	1	22	0	8	-15	19	4	21	0	63	42
Existing v. Alt 8 LLT	15	4	22	9	16	8	21	16	21	4	76	67
NAA v. Alt 8 LLT	15	-1	22	0	16	-7	21	6	21	0	76	55
Existing v. Alt 9 LLT	18	7	23	10	18	10	13	8	21	4	39	30
NAA v. Alt 9 LLT	18	2	23	1	18	-5	13	-2	21	0	39	18

3

1 **11.3.4.3 Alternative 1B—Dual Conveyance with East Alignment and**  
2 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

3 Alternative 1B would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water  
4 routed from the north Delta to the south Delta would be conveyed by gravity through a canal along  
5 the east side of the Delta instead of through pipelines/tunnels. While the five intakes would be  
6 located and constructed on the east bank of the Sacramento River identical to those under  
7 Alternative 1A, the difference in the type of conveyance facility (e.g., canal) results in different  
8 construction details to a limited extent as they relate to potential impacts on fish. Specifically, eight  
9 culvert and three tunnel siphons would be utilized to divert canal water beneath existing water  
10 courses and their construction would occur within those water courses. Alternative 1B would also  
11 have one barge landing and 19 bridge crossings compared to six barge landings and no bridge  
12 crossings for Alternative 1A. Approximately 4,500 barge trips would occur during construction.  
13 Besides the primary difference of utilizing a canal rather than a tunnel, Alternative 1B would have  
14 other structural differences such as inclusion of an intermediate pumping plant and elimination of  
15 the intermediate forebay. However, these latter differences would not affect fish resources and are  
16 not evaluated further in this chapter. Overall, construction impacts from Alternative 1B would be  
17 similar to Alternative 1A but with additional in-water work as described above. However,  
18 implementation of mitigation measures (described below) and environmental commitments (see  
19 Appendix 3B, *Environmental Commitments*) would reduce impacts as described under Alternative  
20 1A.

21 Water supply and conveyance operations would follow the guidelines described as Scenario A,  
22 which is identical to those analyzed under Alternative 1A. CM2–CM22 would be implemented under  
23 this alternative, and these conservation measures would be identical to those under Alternative 1A.  
24 See Chapter 3, *Description of Alternatives*, for additional details on Alternative 1B.

25 **Delta Smelt**

26 **Construction and Maintenance of CM1**

27 The potential effects of construction and maintenance of water conveyance facilities on delta smelt  
28 and their designated critical habitat would be similar to those described under Alternative 1A.  
29 Because no differences in fish effects are anticipated anywhere in the affected environment under  
30 Alternative 1B compared to those described in detail for Alternative 1A (Impact AQUA-1 and AQUA-  
31 2), the effects described for delta smelt under Alternative 1A also appropriately characterize effects  
32 under Alternative 1B.

33 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

34 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

35 The potential effects of construction and maintenance of water conveyance facilities on delta smelt  
36 would be similar to those described under Alternative 1A, Impact AQUA-1 and AQUA-2. Unlike  
37 Alternative 1A, which would convey water from the north Delta to the south Delta through  
38 pipelines/tunnels, Alternative 1B would convey water through a surface canal. The surface canal  
39 conveyance in Alternative 1B would include an east-side canal with eight culvert siphons

1 constructed below the following crossings: Stone Lake drain, Beaver Slough, Hog Slough, Sycamore  
2 Slough, White Slough, Disappointment Slough, BNSF Railroad, and Middle River.

3 Small numbers of delta smelt eggs, larvae, and adults could be present in the Delta in June and July  
4 during construction of intake facilities, barge landing, and invert culvert siphons.

5 As concluded in Alternative 1A, Impact AQUA-1 and AQUA-2, the effects will result in both  
6 temporary and permanent alteration of migration, spawning, and rearing habitats used by delta  
7 smelt. However, these effects are not expected to be adverse from a population standpoint, because  
8 local water quality conditions, very low electrical conductivity and typically low turbidity limit the  
9 suitability of this river reach for delta smelt (Werner et al. 2010). Moreover, any habitat losses will  
10 be offset by habitat restoration and beneficial operational effects on the Delta as a whole.

11 **NEPA Effects:** For the reasons described above, the construction and short-term maintenance  
12 activities would not be adverse for delta smelt.

13 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact  
14 of the construction and maintenance of water conveyance facilities on delta smelt would not be  
15 significant except for construction noise associated with pile driving. Implementation of Mitigation  
16 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
17 significant.

18 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
19 **of Pile Driving and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
22 **and Other Construction-Related Underwater Noise**

23 **Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1. Water**  
24 **Operations of CM1**

25 Alternative 1B has the same diversion and conveyance operations as Alternative 1A. The primary  
26 difference between the two alternatives is that conveyance under Alternative 1B would be in a lined  
27 or unlined canal, instead of a pipeline. Because there would be no difference in conveyance capacity  
28 or operations, there would be no differences between these two alternatives in upstream of the  
29 Delta river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no  
30 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
31 1B compared to those described in detail for Alternative 1A (Impact AQUA-3 through AQUA-6), the  
32 fish effects described for Alternative 1A also appropriately characterize effects under Alternative 1B.

33 The following impacts are those presented under Alternative 1A that are identical for Alternative  
34 1B.

35 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

36 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
37 **Delta Smelt**

38 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

1 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

2 *NEPA Effects:* With the exception of Impact AQUA-5, the other impact mechanisms listed above  
3 would not be adverse to delta smelt under Alternative 1B. This is the same conclusion as described  
4 in detail under Alternative 1A, and is based on the expected overall limited or slightly beneficial  
5 impacts. However, the overall effect of Impact AQUA-5 on delta smelt rearing habitat would remain  
6 adverse because of the potential adverse change in the fall abiotic habitat and the uncertainty  
7 regarding BDCP restoration efforts (see Alternative 1A, AQUA-5 for details on expected effects).

8 *CEQA Conclusion:* The effects of all of the above listed impact mechanisms would be less than  
9 significant, or slightly beneficial to delta smelt, and no mitigation would be required. Detailed  
10 discussions regarding these conclusions are presented in Alternative 1A.

11 **Restoration Measures (CM2, CM4–CM7, and CM10)**

12 Alternative 1B has the same Restoration Measures as Alternative 1A. Because no substantial  
13 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
14 under Alternative 1B compared to those described in detail for Alternative 1A, the fish effects of  
15 restoration measures described for Alternative 1A (Impact AQUA-7 through AQUA-9) also  
16 appropriately characterize effects under Alternative 1B.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative  
18 1B.

19 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

20 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**  
21 **Smelt**

22 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

23 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms  
24 on delta smelt are the same for Alternative 1B, as those described under Alternatives 1A. The effects  
25 could be not adverse and/or generally beneficial. Specifically for AQUA-8, the effects of  
26 contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be  
27 adverse. The effects of methylmercury on delta smelt are uncertain.

28 *CEQA Conclusion:* All three of the impact mechanisms listed above would all be beneficial or less  
29 than significant, because they are intended to increase suitable habitat and habitat functions.  
30 Therefore, no mitigation is required.

31 **Other Conservation Measures (CM12–CM19 and CM21)**

32 Alternative 1B has the same Other Conservation Measures as Alternative 1A. Because no substantial  
33 differences in other conservation measure-related fish effects are anticipated anywhere in the  
34 affected environment under Alternative 1B compared to those described in detail for Alternative 1A,  
35 the fish effects of the other conservation measures described for Alternative 1A (Impact AQUA-10  
36 through AQUA-18) also appropriately characterize effects under Alternative 1B.

37 The following impacts are those presented under Alternative 1A that are identical for Alternative  
38 1B.

1 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

2 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

3 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

4 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

5 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

6 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

7 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

8 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

9 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
10 **(CM21)**

11 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms (Impact AQUA 10  
12 through 18) would be adverse to delta smelt, and some would be at least slightly beneficial.

13 *CEQA Conclusion:* All nine of the impact mechanisms listed above would be at least slightly  
14 beneficial, or less than significant, and no mitigation is required.

## 15 **Longfin Smelt**

16 The potential effects of construction and maintenance of water conveyance facilities on longfin  
17 smelt would be similar to those described under Alternative 1A. Because no differences in fish  
18 effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
19 those described in detail for Alternative 1A (Impact AQUA-19 and AQUA-20), the effects described  
20 for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under  
21 Alternative 1B.

22 The following impacts on longfin smelt are those presented under Alternative 1A that are identical  
23 for Alternative 1B.

24 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

25 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

26 *NEPA Effects:* These impact mechanisms would not be adverse to longfin smelt, although  
27 construction activities could result in adverse effects from impact pile driving activities. However,  
28 the implementation of the avoidance and minimization measures and Mitigation Measures AQUA-1a  
29 and AQUA-1b (described under Impact AQUA-1 in Alternative 1A for delta smelt) would minimize or  
30 eliminate adverse effects (e.g., injury or mortality).

31 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-19  
32 could result in significant underwater noise effects from impact pile driving, although  
33 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
34 impacts to less than significant.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

7           **Water Operations of CM1**

8           The potential effects of water conveyance facility operations on longfin smelt would be similar to  
9           those described under Alternative 1A. Because no differences in fish effects are anticipated  
10          anywhere in the affected environment under Alternative 1B compared to Alternative 1A (Impact  
11          AQUA-21 through AQUA-24), the effects described for longfin smelt under Alternatives 1A also  
12          appropriately characterize effects under Alternative 1B.

13          **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

14          **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**  
15          **Habitat for Longfin Smelt**

16          **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

17          Discussion provided above, under Impact AQUA-22

18          **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

19          Discussion provided above, under Impact AQUA-22

20          **NEPA Effects:** As discussed under Impact AQUA-21 through AQUA-24 in Alternative 1A, the effect of  
21          lower Delta winter-spring outflow under Alternative 1B on longfin smelt spawning and rearing has  
22          the potential to be adverse. This effect is a result of the specific reservoir operations, exports and  
23          resulting flows associated with this alternative. However, Alternative 1B includes an adaptive  
24          management plan that could be used to adjust spring operations as determined necessary through  
25          the adaptive management process. These adaptive management procedures are described in  
26          Mitigation Measures 22a through 22c, under Alternative 1A.

27          **CEQA Conclusion:** These impact mechanisms could result in significant effects to longfin smelt given  
28          the outflow-abundance relationship described by Kimmerer et al. (2009), although there are  
29          uncertainties regarding the outcome as a result of habitat restoration, and changes in winter-spring  
30          outflow. However, implementation of Mitigation Measures AQUA-22a through 22c, habitat  
31          restoration, and reduced larval entrainment would reduce this impact to less than significant, so no  
32          additional mitigation would be required.

33          **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**  
34          **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**  
35          **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

36          Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

1           **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**  
2           **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

3           Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

4           **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**  
5           **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

6           Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

7           **Restoration and Conservation Measures**

8           The potential effects of restoration measures and other conservation measures on longfin smelt  
9           would be similar to those described under Alternative 1A. Because no differences in fish effects are  
10          anticipated anywhere in the affected environment under Alternative 1B compared to those  
11          described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the effects described for  
12          longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under  
13          Alternative 1B.

14          **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

15          **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**  
16          **Smelt**

17          **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

18          **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

19          **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
20          **(CM13)**

21          **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

22          **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

23          **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

24          **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

25          **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

26          **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

27          **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
28          **(CM21)**

29          **NEPA Effects:** The impact mechanisms listed above would range from no effect, to no adverse effect,  
30          or beneficial effects on longfin smelt for the reasons identified for Alternative 1A. Specifically for  
31          AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia  
32          and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
2 mechanisms would range from no impact, to less than significant, or beneficial for longfin smelt for  
3 the reasons identified under Alternative 1A, and no mitigation would be required.

#### 4 **Winter-Run Chinook Salmon**

##### 5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance of water conveyance facilities on winter-run  
7 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
8 fish effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
9 those described in detail for Alternative 1A (Impact AQUA-37 and AQUA-38), the effects described  
10 for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects for  
11 winter-run Chinook salmon under Alternative 1B.

##### 12 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 13 **(Winter-Run ESU)**

##### 14 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 15 **(Winter-Run ESU)**

16 **NEPA Effects:** These impact mechanisms would not be adverse to winter-run Chinook salmon. While  
17 construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving  
18 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
19 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

20 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-37  
21 could result in significant underwater noise effects from impact pile driving, although  
22 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
23 impacts to less than significant.

##### 24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

##### 27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

##### 30 **Water Operations of CM1**

31 The potential effects of operations of water conveyance facilities on winter-run Chinook salmon  
32 would be similar to those described for Alternative 1A. Because no differences in fish effects are  
33 anticipated anywhere in the affected environment under Alternative 1B compared to those  
34 described in detail for Alternative 1A (Impacts AQUA-39 through AQUA-42), the effects described  
35 for winter-run Chinook salmon also appropriately characterize the effects under Alternative 1B.

##### 36 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-** 37 **Run ESU)**

1 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Chinook Salmon (Winter-Run ESU)**

3 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
4 **(Winter-Run ESU)**

5 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
6 **(Winter-Run ESU)**

7 *NEPA Effects:* Although analysis conducted as part of the EIR/EIS determined that Alternative 1B  
8 would have unavoidable adverse effects on winter-run Chinook salmon spawning, incubation,  
9 and/or rearing habitat, as well as overall migration conditions. This conclusion was based on the  
10 best available scientific information at the time and may prove to have been over- or understated.  
11 The effects are a result of the specific reservoir operations and resulting flows associated with this  
12 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
13 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
14 the alternative, thereby making it a different alternative than that which has been modeled and  
15 analyzed. As a result, these would be unavoidable adverse effects. The implementation of the  
16 mitigation measures listed below would reduce the severity of effects, although not necessarily to a  
17 not adverse level.

18 *CEQA Conclusion:* Similar to the discussion provided above, and for Alternative 1A, these impact  
19 mechanisms would have a significant effect on winter-run Chinook salmon spawning, incubation,  
20 and rearing habitat and/or migration conditions under Alternative 1B. The implementation of the  
21 mitigation measures listed below would reduce the severity of effects, although not necessarily to a  
22 less than significant level.

23 Upon the commencement of operations of CM1 and continuing through the life of the permit, the  
24 BDCP proponents will monitor potential effects on spawning, incubation, and rearing habitat to  
25 determine whether such effects would be as extensive as concluded at the time of preparation of this  
26 document and to determine any potentially feasible means of reducing the severity of such effects.  
27 This mitigation measure requires a series of actions to accomplish these purposes, consistent with  
28 the operational framework for Alternative 1B.

29 The development and implementation of any mitigation actions shall be focused on those  
30 incremental effects attributable to implementation of Alternative 1B operations only, and not effects  
31 of climate change or sea level rise. Development of mitigation actions for the incremental impact on  
32 winter-run Chinook salmon habitat attributable to climate change/sea level rise are not required  
33 because these changed conditions would occur with or without implementation of Alternative 1B.  
34 The mitigation measures identified below would provide an adaptive management process, that  
35 may be conducted as a part of the Adaptive Management and Monitoring Program required by the  
36 BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate  
37 minimization measures.

38 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional**  
39 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
40 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

41 Please refer to Mitigation Measure AQUA-40a under Alternative 1A (Impact AQUA-40) for  
42 winter-run Chinook salmon.

1       **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts**  
2       **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

3       Please refer to Mitigation Measure AQUA-40b under Alternative 1A (Impact AQUA-40) for  
4       winter-run Chinook salmon.

5       **Mitigation Measure AQUA-40c: Consult with USFWS and CDFW to Identify and Implement**  
6       **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Spawning**  
7       **Habitat Consistent with CM1**

8       Please refer to Mitigation Measure AQUA-40c under Alternative 1A (Impact AQUA-40) for  
9       winter-run Chinook salmon.

10       **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**  
11       **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
12       **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

13       Please refer to Mitigation Measure AQUA-41a under Alternative 1A (Impact AQUA-41) for  
14       winter-run Chinook salmon.

15       **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**  
16       **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

17       Please refer to Mitigation Measure AQUA-41b under Alternative 1A (Impact AQUA-41) for  
18       winter-run Chinook salmon.

19       **Mitigation Measure AQUA-41c: Consult with USFWS and CDFW to Identify and Implement**  
20       **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Rearing**  
21       **Habitat Consistent with CM1**

22       Please refer to Mitigation Measure AQUA-41c under Alternative 1A (Impact AQUA-41) for  
23       winter-run Chinook salmon.

24       **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**  
25       **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
26       **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

27       Please refer to Mitigation Measure AQUA-42a under Alternative 1A (Impact AQUA-41) for  
28       winter-run Chinook salmon.

29       **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**  
30       **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

31       Please refer to Mitigation Measure AQUA-42b under Alternative 1A (Impact AQUA-41) for  
32       winter-run Chinook salmon.

33       **Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement**  
34       **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration**  
35       **Conditions Consistent with CM1**

36       Please refer to Mitigation Measure AQUA-42c under Alternative 1A (Impact AQUA-41) for  
37       winter-run Chinook salmon.

1 **Restoration and Conservation Measures**

2 The potential effects of restoration measures and other conservation measures on winter-run  
3 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
4 fish effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
5 those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects  
6 described for winter-run Chinook salmon under Alternative 1A also appropriately characterize  
7 effects under Alternative 1B.

8 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
9 **(Winter-Run ESU)**

10 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
11 **Salmon (Winter-Run ESU)**

12 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
13 **ESU)**

14 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
15 **ESU) (CM12)**

16 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
17 **(Winter-Run ESU) (CM13)**

18 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
19 **Run ESU) (CM14)**

20 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
21 **(Winter-Run ESU) (CM15)**

22 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
23 **(CM16)**

24 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
25 **(CM17)**

26 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
27 **(CM18)**

28 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
29 **ESU) (CM19)**

30 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
31 **(Winter-Run ESU) (CM21)**

32 *NEPA Effects:* As discussed in detail for Alternative 1A, these impact mechanisms would not be  
33 adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for AQUA-44,  
34 the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper,  
35 ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook  
36 salmon are uncertain.

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, most of these impact  
2 mechanisms would be beneficial or less than significant, and no mitigation would be required.

### 3 **Spring-Run Chinook Salmon**

#### 4 **Construction and Maintenance of CM1**

5 The potential effects of construction and maintenance of water conveyance facilities on spring-run  
6 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
7 fish effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
8 those described in detail for Alternative 1A (Impact AQUA-55 and AQUA-56), the effects described  
9 for spring-run Chinook salmon under Alternative 1A also appropriately characterize effects for  
10 spring-run Chinook salmon under Alternative 1B.

#### 11 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 12 **(Spring-Run ESU)**

#### 13 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 14 **(Spring-Run ESU)**

15 **NEPA Effects:** While construction activities (Impact AQUA-55) could result in adverse effects from  
16 impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b,  
17 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality). The  
18 periodic and short-term maintenance activities would not be adverse.

19 **CEQA Conclusion:** Similar to the discussion provided above for Alternatives 1A, Impact AQUA-55  
20 could result in significant underwater noise effects from impact pile driving, although  
21 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
22 impacts to less than significant.

#### 23 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 24 **of Pile Driving and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

#### 26 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 27 **and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

#### 29 **Water Operations of CM1**

30 The potential effects of water conveyance facility operations on spring-run Chinook salmon would  
31 be similar to those described under Alternative 1A. Because no differences in fish effects are  
32 anticipated anywhere in the affected environment under Alternative 1B compared to those  
33 described in detail for Alternative 1A (Impact AQUA-57 and AQUA-60), the effects described for  
34 spring-run Chinook salmon under Alternative 1A also appropriately characterize effects under  
35 Alternative 1B.

1 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
2 **ESU)**

3 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
4 **Chinook Salmon (Spring-Run ESU)**

5 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**  
6 **Run ESU)**

7 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
8 **(Spring-Run ESU)**

9 **NEPA Effects:** As discussed in detail for Alternative 1A, the effects of Alternative 1B operations on  
10 entrainment, spawning and egg incubation habitat, and through-Delta migration conditions for  
11 spring-run Chinook salmon would be adverse due to predation and habitat loss associated with the  
12 five intakes of the north Delta facilities, and flow changes in the Feather River. However, the  
13 implementation of applicable conservation measures (CM6, *Channel Margin Enhancement* and  
14 CM15, *Predator Control*), as described in Chapter 3, Section 3.6, would minimize potential effects. In  
15 addition, the implementation of the mitigation measures listed below also has the potential to  
16 reduce the severity of the impact to migration conditions, although not necessarily to a not adverse  
17 level. These mitigation measures would provide an adaptive management process, that may be  
18 conducted as a part of the Adaptive Management and Monitoring Program required by the BDCP  
19 (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate minimization  
20 measures.

21 **CEQA Conclusion:** As discussed above, and in detail for Alternative 1A, the effects of the impact  
22 mechanisms listed above (except for Impact AQUA-59) would be significant under Alternative 1B for  
23 spring-run Chinook salmon. However, differences between Alternative 1B (which is under LLT  
24 conditions that include future sea level rise and climate change) and Existing Conditions may  
25 therefore either overstate the effects of Alternative 1B, or suggest significant effects that are largely  
26 attributable to sea level rise and climate change rather than the alternative. Based on the overall  
27 assessment, Alternative 1B could result in a significant and unavoidable effect on migration  
28 conditions. While the mitigation measures listed below would reduce the severity of effects, they are  
29 likely to remain significant and unavoidable.

30 **Mitigation Measure AQUA-58a: Following Initial Operations of CM1, Conduct Additional**  
31 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
32 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

33 Please refer to Mitigation Measure AQUA-58a under Alternative 1A (Impact AQUA-60) for  
34 spring-run Chinook salmon.

35 **Mitigation Measure AQUA-58b: Conduct Additional Evaluation and Modeling of Impacts**  
36 **on Spring-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

37 Please refer to Mitigation Measure AQUA-58b under Alternative 1A (Impact AQUA-60) for  
38 spring-run Chinook salmon.

1           **Mitigation Measure AQUA-58c: Consult with USFWS and CDFW to Identify and Implement**  
2           **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Spawning**  
3           **Habitat Consistent with CM1**

4           Please refer to Mitigation Measure AQUA-58c under Alternative 1A (Impact AQUA-60) for  
5           spring-run Chinook salmon.

6           **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**  
7           **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
8           **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

9           Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for  
10          spring-run Chinook salmon.

11          **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**  
12          **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

13          Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for  
14          spring-run Chinook salmon.

15          **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**  
16          **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**  
17          **Conditions Consistent with CM1**

18          Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for  
19          spring-run Chinook salmon.

20          **Restoration and Conservation Measures**

21          The potential effects of restoration measures and other conservation measures on spring-run  
22          Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
23          fish effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
24          those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the  
25          effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects  
26          under Alternative 1B.

27          **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**  
28          **(Spring-Run ESU)**

29          **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**  
30          **Salmon (Spring-Run ESU)**

31          **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

32          **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
33          **ESU) (CM12)**

34          **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
35          **(Spring-Run ESU) (CM13)**

1 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
2 **Run ESU) (CM14)**

3 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
4 **(Spring-Run ESU) (CM15)**

5 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
6 **(CM16)**

7 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
8 **(CM17)**

9 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
10 **(CM18)**

11 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
12 **ESU) (CM19)**

13 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
14 **(Spring-Run ESU) (CM21)**

15 *NEPA Effects:* As discussed for Alternative 1A, the above listed impact mechanisms would not be  
16 adverse, and with the implementation of environmental commitments and conservation measures,  
17 the effects would typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the  
18 effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia  
19 and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon  
20 are uncertain.

21 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
22 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 23 **Fall-/Late Fall–Run Chinook Salmon**

### 24 **Construction and Maintenance of CM1**

25 The potential effects of construction and maintenance of water conveyance facilities on fall- and late  
26 fall-run Chinook salmon would be similar to those described under Alternative 1A. Because no  
27 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
28 1B compared to those described in detail for Alternative 1A (Impact AQUA-73 and AQUA-74), the  
29 fish effects described for fall- and late fall-run Chinook salmon under Alternative 1A also  
30 appropriately characterize effects under Alternative 1B.

31 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
32 **(Fall-/Late Fall–Run ESU)**

33 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
34 **(Fall-/Late Fall–Run ESU)**

35 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
36 would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact

1 AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of  
2 Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from  
3 impact pile driving (e.g., injury or mortality).

4 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-73  
5 could result in significant underwater noise effects from impact pile driving, although  
6 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
7 impacts to less than significant.

8 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
9 **of Pile Driving and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

11 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
12 **and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

14 **Water Operations of CM1**

15 The potential effects of water conveyance facility operations on fall- and late fall-run Chinook  
16 salmon would be similar to those described for Alternative 1A. Because no differences in fish effects  
17 are anticipated anywhere in the affected environment under Alternative 1B compared to those  
18 described in detail for Alternative 1A (Impacts AQUA-75 through AQUA-78), the effects described  
19 for fall- and late fall-run Chinook salmon also appropriately characterize the effects for Alternative  
20 1B.

21 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
22 **Fall-Run ESU)**

23 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
24 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

25 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
26 **(Fall-/Late Fall-Run ESU)**

27 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
28 **(Fall-/Late Fall-Run ESU)**

29 **NEPA Effects:** As indicated under Alternative 1A, the analysis results indicate that the effect of  
30 Alternative 1B is adverse because it has the potential to substantially interfere with the movement  
31 of fall-/late fall-run Chinook salmon. This would include adverse effects on fall-/late fall-run  
32 Chinook salmon through-delta migration conditions on the Sacramento River, relative to NAA, while  
33 through-Delta conditions on the San Joaquin River would be positive. The implementation of the  
34 conservation and mitigation measures listed below also has the potential to reduce the severity of  
35 the impact though not necessarily to a not adverse level.

36 **CEQA Conclusion:** The effects of Alternative 1B would be similar to those discussed above under  
37 Alternative 1A. The implementation of applicable conservation measures (CM6, *Channel Margin*  
38 *Enhancement* and CM15, *Predator Control*), as described in Chapter 3, Section 3.6, would minimize

1 potential effects. In addition, the implementation of the mitigation measures listed below also has  
2 the potential to reduce the severity of the impact though not necessarily to a less-than-significant  
3 level. These mitigation measures would provide an adaptive management process, that could be  
4 conducted as a part of the Adaptive Management and Monitoring Program required by the BDCP  
5 (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate minimization  
6 measures.

7 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
8 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
9 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

10 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for  
11 fall/late fall-run Chinook salmon.

12 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
13 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
14 **of CM1**

15 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for  
16 fall/late fall-run Chinook salmon.

17 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
18 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
19 **Migration Conditions Consistent with CM1**

20 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for  
21 fall/late fall-run Chinook salmon.

22 **Restoration and Conservation Measures**

23 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/**  
24 **Late Fall-Run ESU)**

25 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**  
26 **Salmon (Fall-/Late Fall-Run ESU)**

27 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**  
28 **Run ESU)**

29 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**  
30 **Run ESU) (CM12)**

31 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
32 **(Fall-/Late Fall-Run ESU) (CM13)**

33 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**  
34 **/Late Fall-Run ESU) (CM14)**

35 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/**  
36 **Late Fall-Run ESU) (CM15)**

1 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**  
2 **Run ESU) (CM16)**

3 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**  
4 **ESU) (CM17)**

5 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**  
6 **ESU) (CM18)**

7 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
8 **Fall-Run ESU) (CM19)**

9 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
10 **(Fall-/Late Fall-Run ESU) (CM21)**

11 *NEPA Effects:* As discussed in detail for Alternative 1A, these restoration and conservation  
12 commitment impact mechanisms (Impact AQUA-79 through AQUA-90), would not be adverse, and  
13 would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the  
14 effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper,  
15 ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-  
16 run Chinook salmon are uncertain.

17 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
18 mechanisms would be beneficial or less than significant, and no mitigation would be required.

19 **Steelhead**

20 The potential effects of construction and maintenance of water conveyance facilities, operations of  
21 water conveyance facilities, restoration measures and other conservation measures on steelhead  
22 would be similar to those described under Alternatives 1A.

23 **Construction and Maintenance of CM1**

24 The potential effects of construction and maintenance of water conveyance facilities on steelhead  
25 would be similar to those described under Alternative 1A. Because no differences in fish effects are  
26 anticipated anywhere in the affected environment under Alternative 1B compared to those  
27 described in detail for Alternative 1A (Impact AQUA-91 and AQUA-92), the fish effects described for  
28 steelhead under Alternative 1A also appropriately characterize effects under Alternative 1B.

29 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

30 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

31 *NEPA Effects:* These impact mechanisms would typically not be adverse to steelhead. While  
32 construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving  
33 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
34 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

35 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-91  
36 could result in significant underwater noise effects from impact pile driving, although

1 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
2 impacts to less than significant.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

6 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
7 **and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

9 **Water Operations of CM1**

10 The potential effects of water conveyance facility operations on steelhead would be similar to those  
11 described above under Alternative 1A. Because no differences in fish effects are anticipated  
12 anywhere in the affected environment under Alternative 1B compared to those described in detail  
13 for Alternative 1A (Impact AQUA-93 through AQUA-96), the effects described for steelhead under  
14 Alternative 1A also appropriately characterize effects under Alternative 1B.

15 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

16 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
17 **Steelhead**

18 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

19 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

20 *NEPA Effects:* As described in detail under Alternative 1A, these impact mechanisms would result in  
21 variable effects on steelhead, but the effects would not result in biologically meaningful reductions  
22 in overall survival of steelhead. Therefore, the effects would not be adverse to steelhead under  
23 Alternative 1B.

24 *CEQA Conclusion:* Collectively, the analysis indicates that the difference between the CEQA baseline  
25 and Alternative 1B could be significant because, under the CEQA baseline, the alternative could  
26 substantially reduce the amount of suitable habitat and interfere with steelhead migrations in some  
27 areas. Alternative 1B would also negatively affect juvenile and adult migration conditions in some  
28 areas. Despite the variability in effects of Alternative 1B, if adjusted to exclude sea level rise and  
29 climate change, the alternative would not in itself result in a significant impact on steelhead.

30 **Restoration and Conservation Measures**

31 The potential effects of restoration measures and other conservation measures on steelhead would  
32 be similar to those described under Alternative 1A. Because no differences in fish effects are  
33 anticipated anywhere in the affected environment under Alternative 1B, compared to those  
34 described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the effects described  
35 for steelhead under Alternative 1A also appropriately characterize the effects under Alternative 1B.

36 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

1 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

2 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

3 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

4 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

5 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

6 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

7 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

8 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

9 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

10 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

11 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
12 **(CM21)**

13 **NEPA Effects:** As discussed for Alternative 1A, these impact mechanisms would not be adverse, and  
14 would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of contaminants on  
15 steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The  
16 effects of methylmercury on steelhead are uncertain.

17 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
18 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 19 **Sacramento Splittail**

20 The potential effects of construction and maintenance of water conveyance facilities, operations of  
21 water conservation facilities, restoration measures and other conservation measures on Sacramento  
22 splittail would be similar to those described under Alternative 1A.

### 23 **Construction and Maintenance of CM1**

24 The potential effects of construction and maintenance of water conveyance facilities would be  
25 similar to those described under Alternative 1A, because no differences in fish effects are  
26 anticipated anywhere in the affected environment under Alternative 1B compared to those  
27 described in detail for Alternative 1A (Impact AQUA-109 and AQUA-110). Therefore, the effects  
28 described for Sacramento splittail under Alternative 1A also appropriately characterize effects for  
29 Sacramento splittail under Alternative 1B.

30 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**  
31 **Splittail**

32 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
33 **Splittail**

1 **NEPA Effects:** These impact mechanisms would generally not be adverse to Sacramento splittail.  
2 While construction activities (Impact AQUA-109) could result in adverse effects from impact pile  
3 driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
4 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

5 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-109  
6 could result in significant underwater noise effects from impact pile driving, although  
7 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
8 impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no  
9 additional mitigation would be required.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

13 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
14 **and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

16 **Water Operations of CM1**

17 The potential effects of water conveyance facility operations on Sacramento splittail would be  
18 similar to those described for Alternative 1A. Because no differences in fish effects are anticipated  
19 anywhere in the affected environment under Alternative 1B, compared to those described in detail  
20 for Alternative 1A (Impacts AQUA-111 through AQUA-114), the effects described under Alternative  
21 1A would also appropriately characterize the effects under Alternative 1B.

22 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

23 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
24 **Sacramento Splittail**

25 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

26 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
27 **Splittail**

28 **NEPA Effects:** As discussed in detail for Alternative 1A, the operations impact mechanisms would  
29 not be adverse to Sacramento splittail.

30 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
31 mechanisms would be less than significant, and no mitigation would be required.

32 **Restoration and Conservation Measures**

33 The potential effects of restoration measures and other conservation measures on Sacramento  
34 splittail would be similar to those described for Alternative 1A. Because no differences in fish effects  
35 are anticipated anywhere in the affected environment under Alternative 1B compared to those

1 described in detail for Alternative 1A (Impacts AQUA-115 through AQUA-126), the fish effects  
2 described also appropriately characterize the effects under Alternative 1B.

3 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

4 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**  
5 **Sacramento Splittail**

6 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

7 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

8 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**  
9 **Splittail (CM13)**

10 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
11 **(CM14)**

12 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
13 **(CM15)**

14 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

15 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

16 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

17 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

18 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**  
19 **Splittail (CM21)**

20 **NEPA Effects:** As discussed for Alternative 1A, the other impact mechanisms would not be adverse,  
21 and would typically be beneficial to Sacramento splittail. Specifically for AQUA-116, the effects of  
22 contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides  
23 would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

24 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, most of these impact  
25 mechanisms would be beneficial or less than significant, and no mitigation would be required.

26 **Green Sturgeon**

27 The potential effects of construction and maintenance of water conveyance facilities, operations of  
28 water conservation facilities, restoration measures and other conservation measures on green  
29 sturgeon would be similar to those described under Alternative 1A.

30 **Construction and Maintenance of CM1**

31 The potential effects of construction and maintenance activities on green sturgeon would be similar  
32 to those described under Alternative 1A, because no differences in fish effects are anticipated  
33 anywhere in the affected environment under Alternative 1B compared to those described in detail

1 for Alternative 1A (Impact AQUA-127 and AQUA-128), Therefore, the fish effects described for green  
2 sturgeon under Alternative 1A also appropriately characterize effects for green sturgeon under  
3 Alternative 1B.

4 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

5 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

6 **NEPA Effects:** Construction activities (Impact AQUA-127) could result in adverse effects from impact  
7 pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and AQUA-1b,  
8 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).  
9 However, maintenance activities (Impact AQUA-128) would not be adverse to green sturgeon.

10 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-127  
11 could result in significant underwater noise effects from impact pile driving, although  
12 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
13 impacts to less than significant. The other impact mechanism would be less than significant, so no  
14 additional mitigation would be required.

15 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
16 **of Pile Driving and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

18 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
19 **and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

21 **Water Operations of CM1**

22 The potential effects of water conveyance operations on green sturgeon would be similar to those  
23 described for Alternative 1A. Because no differences in fish effects are anticipated anywhere in the  
24 affected environment under Alternative 1B compared to those described in detail for Alternative 1A  
25 (Impacts AQUA-129 through AQUA-132). Therefore, the effects described for green sturgeon under  
26 Alternative 1A, also appropriately characterize the effects under Alternative 1B.

27 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

28 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
29 **Green Sturgeon**

30 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

31 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

32 **NEPA Effects:** As discussed for Alternative 1A, Impact AQUA-132 is expected to negatively affect  
33 green sturgeon migration habitat conditions under Alternative 1B. These effects are a result of the  
34 specific reservoir operations and resulting flows associated with this alternative. Therefore, while  
35 there is no feasible mitigation available, the implementation of the mitigation measures listed below

1 has the potential to reduce the severity of the impact, but not necessarily to a level considered to be  
2 not adverse.

3 **CEQA Conclusion:** Similar to the discussion provided above, and for Alternative 1A, Impact AQUA-  
4 132 could result in significant, but unavoidable effects on water temperature, juvenile and adult  
5 green sturgeon migration habitat conditions, compared to Existing Conditions. Implementation of  
6 the mitigation measures listed below has the potential to reduce the severity of the impact though  
7 not necessarily to a less-than-significant level. These mitigation measures would provide an  
8 adaptive management process, that may be conducted as a part of the Adaptive Management and  
9 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing  
10 impacts and developing appropriate minimization measures.

11 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**  
12 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**  
13 **Mitigation to Reduce Impacts to Migration Conditions**

14 Please refer to Mitigation Measure AQUA-132a under Alternative 1A (Impact AQUA-132) for  
15 green sturgeon.

16 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
17 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

18 Please refer to Mitigation Measure AQUA-132b under Alternative 1A (Impact AQUA-132) for  
19 green sturgeon.

20 **Mitigation Measure AQUA-132c: Consult with USFWS and CDFW to Identify and**  
21 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
22 **Conditions Consistent with CM1**

23 Please refer to Mitigation Measure AQUA-132c under Alternative 1A (Impact AQUA-132) for  
24 green sturgeon.

25 **Restoration and Conservation Measures**

26 Alternative 1B has the same restoration and conservation measures as Alternative 1A. Because no  
27 substantial differences in fish effects are anticipated anywhere in the affected environment under  
28 Alternative 1B compared to those described in detail for Alternative 1A, the effects of the restoration  
29 and conservation measures would be similar.

30 The following impacts are those presented under Alternative 1A that are identical for Alternative  
31 1B.

32 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

33 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**  
34 **Sturgeon**

35 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

36 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

1 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
2 **(CM13)**

3 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

4 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
5 **(CM15)**

6 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

7 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

8 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

9 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

10 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
11 **Sturgeon (CM21)**

12 **NEPA Effects:** These impact mechanisms would not be adverse, and with the implementation of  
13 environmental commitments and conservation measures, the effects would typically be beneficial to  
14 green sturgeon. Specifically for AQUA-134, the effects of contaminants on green sturgeon with  
15 respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and  
16 selenium on green sturgeon are uncertain.

17 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
18 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 19 **White Sturgeon**

20 The potential effects of construction and maintenance of water conveyance facilities, operations of  
21 water conservation facilities, restoration measures and other conservation measures on white  
22 sturgeon would be similar to those described under Alternative 1A.

### 23 **Construction and Maintenance of CM1**

24 The potential effects of construction and maintenance activities on white sturgeon would be similar  
25 to those described under Alternative 1A, because no differences in fish effects are anticipated  
26 anywhere in the affected environment under Alternative 1B compared to those described in detail  
27 for Alternative 1A (Impact AQUA-145 and AQUA-146). Therefore, the fish effects described for white  
28 sturgeon under Alternative 1A also appropriately characterize effects for white sturgeon under  
29 Alternative 1B.

30 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

31 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

32 **NEPA Effects:** As concluded for Alternative 1A (Impact AQUA-145 and AQUA-146), environmental  
33 commitments and mitigation measures would be available to avoid and minimize potential effects,  
34 so the effect would not be adverse for white sturgeon.

1 **CEQA Conclusion:** As described under Alternative 1A (Impact AQUA-145 and AQUA-146), the  
2 impact of the construction and maintenance of water conveyance facilities on white sturgeon would  
3 be less than significant except for construction noise associated with pile driving. Implementation of  
4 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
5 less than significant.

6 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
7 **of Pile Driving and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

9 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
10 **and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

12 **Water Operations of CM1**

13 The potential effects of operations of water conveyance facilities on white sturgeon would be similar  
14 to those described for Alternative 1A. Because no differences in fish effects are anticipated  
15 anywhere in the affected environment under Alternative 1B compared to those described in detail  
16 for Alternative 1A (Impacts AQUA-147 through AQUA-150), the effects described for white sturgeon  
17 also appropriately characterize the effects under Alternative 1B.

18 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

19 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
20 **White Sturgeon**

21 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

22 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

23 **NEPA Effects:** As discussed above under Alternative 1A, the available information indicates that  
24 overall entrainment effects on white sturgeon populations, on available spawning, rearing or  
25 migration habitat conditions are not expected to substantially change under Alternative 1B  
26 compared to NAA. However, targeted investigations will be implemented to deal with scientific  
27 uncertainty regarding the mechanisms responsible for the positive correlation between year class  
28 strength and river/Delta flow. If upstream conditions are determined to be the primary  
29 mechanisms, then Alternative 1B would not be adverse, but if the positive correlation is related to  
30 in-Delta and through-Delta flow conditions, then Alternative 1B would be deemed adverse due to  
31 the magnitude of reductions in through-Delta flow conditions in Alternative 1B as compared to NAA.

32 **CEQA Conclusion:** As described for Alternative 1A, operational activities could result in a slight  
33 decrease in entrainment of white sturgeon, although the other impact mechanism could  
34 substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above.  
35 There would also be small to moderate decreases in flows during most of the spawning and egg  
36 incubation period in some areas. However, Alternative 1B does not have the potential to  
37 substantially reduce the amount of suitable rearing habitat and substantially interfere with the  
38 movement of fish. Overall, the differences between Existing Conditions and Alternative 1B would

1 generally be due to climate change, sea level rise, and future demand, and not the alternative.  
2 Therefore, this impact is found to be less than significant and no mitigation is required.

### 3 **Restoration and Conservation Measures**

4 Alternative 1B has the same restoration and conservation measures as Alternative 1A. Because no  
5 substantial differences in fish effects are anticipated anywhere in the affected environment under  
6 Alternative 1B compared to those described in detail for Alternative 1A, the effects of these  
7 measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact  
8 AQUA-162) also appropriately characterize effects under Alternative 1B.

#### 9 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

#### 10 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 11 **Sturgeon**

#### 12 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

#### 13 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

#### 14 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon** 15 **(CM13)**

#### 16 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

#### 17 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon** 18 **(CM15)**

#### 19 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

#### 20 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

#### 21 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

#### 22 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

#### 23 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White** 24 **Sturgeon (CM21)**

25 **NEPA Effects:** The restoration and conservation measure impact mechanisms have been determined  
26 to range from no effect, to no adverse effect, or beneficial effects on white sturgeon for NEPA  
27 purposes, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically  
28 for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and  
29 pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are  
30 uncertain.

31 **CEQA Conclusion:** The restoration and conservation measure impact mechanisms would be  
32 considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the  
33 reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is  
34 required.

1 **Pacific Lamprey**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of  
3 water conservation facilities, restoration measures and other conservation measures on Pacific  
4 lamprey would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance of water conveyance facilities on Pacific  
7 lamprey would be similar to those described under Alternative 1A, because no differences in fish  
8 effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
9 those described in detail for Alternative 1A (Impact AQUA-163 through AQUA-180). Therefore, the  
10 effects described for Pacific lamprey under Alternative 1A also appropriately characterize effects for  
11 Pacific lamprey under Alternative 1B.

12 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

13 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

14 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-163 and AQUA-164, environmental  
15 commitments and mitigation measures would be available to avoid and minimize potential effects,  
16 and the effect would not be adverse for Pacific lamprey.

17 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-163 and AQUA-164, the impact  
18 of the construction and maintenance of water conveyance facilities on Pacific lamprey would be less  
19 than significant except for construction noise associated with pile driving. Implementation of  
20 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
21 less than significant.

22 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
23 **of Pile Driving and Other Construction-Related Underwater Noise**

24 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

25 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
26 **and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

28 **Water Operations of CM1**

29 The potential effects of water conveyance facility operations on Pacific lamprey would be similar to  
30 those described under Alternative 1A. Because no differences in fish effects are anticipated  
31 anywhere in the affected environment under Alternative 1B compared to those described in detail  
32 for Alternative 1A (Impact AQUA-165 and Impact AQUA-168), the effects described for Pacific  
33 lamprey under Alternative 1A also appropriately characterize effects for Pacific lamprey under  
34 Alternative 1B.

35 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

1 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Pacific Lamprey**

3 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

4 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

5 **NEPA Effects:** Similar to the results discussed in detail under Alternative 1A, effects on entrainment  
6 of Pacific lamprey would not be adverse, and could be beneficial, due to design, installation, and  
7 operation of new screens in the north Delta. However, flow reductions would be expected to  
8 increase redd dewatering risk and exposure risk to egg cohorts in some areas, such as below  
9 Thermalito Afterbay. These effects would cause substantial reductions in habitat available for  
10 spawning and egg incubation in the Feather River, and reduce overall spawning success. While the  
11 implementation of the mitigation measures listed below (Mitigation Measures AQUA-166a through  
12 AQUA-166c) would reduce the severity of effects, this would not necessarily result in a not adverse  
13 determination. However, the changes in flow would not substantially interfere with the movement  
14 of fish. While the implementation of the mitigation measures listed below (Mitigation Measures  
15 AQUA-166a through AQUA-166c) would reduce the severity of effects, this would not necessarily  
16 result in a not adverse determination.

17 **CEQA Conclusions:** As concluded under Alternative 1A, Alternative 1B water operations could  
18 substantially reduce the number of fish as a result of increased exposure to redd dewatering and  
19 elevated water temperatures, which would reduce egg survival and increase ammocoete mortality.  
20 While the implementation of the mitigation measures listed below (Mitigation Measures AQUA-166a  
21 through AQUA-166c) would reduce the severity of effects, this would not necessarily result in a less  
22 than significant determination. Alternative 1A would also substantially reduce rearing habitat.  
23 However, if adjusted to exclude the effects of sea level rise and climate change, Alternative 1B would  
24 not in itself result in a significant impact on rearing habitat for Pacific lamprey. This impact is found  
25 to be less than significant and no mitigation is required.

26 **Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional**  
27 **Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of**  
28 **Mitigation to Reduce Impacts to Spawning Habitat**

29 Please refer to Mitigation Measure AQUA-166a under Impact AQUA-166 of Alternative 1A.

30 **Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts**  
31 **on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1**

32 Please refer to Mitigation Measure AQUA-166b under Impact AQUA-166 of Alternative 1A.

33 **Mitigation Measure AQUA-166c: Consult with USFWS and CDFW to Identify and**  
34 **Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning**  
35 **Habitat Consistent with CM1**

36 Please refer to Mitigation Measure AQUA-166c under Impact AQUA-166 of Alternative 1A.

37 **Restoration and Conservation Measures**

38 Alternative 1B has the same restoration and conservation measures as Alternative 1A. Because no  
39 substantial differences in fish effects are anticipated anywhere in the affected environment under

1 Alternative 1B compared to those described in detail for Alternative 1A, the effects of these  
2 measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact  
3 AQUA-180) also appropriately characterize effects under Alternative 1B.

4 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

5 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**  
6 **Lamprey**

7 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

8 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

9 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**  
10 **(CM13)**

11 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

12 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**  
13 **(CM15)**

14 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

15 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

16 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

17 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

18 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
19 **Lamprey (CM21)**

20 *NEPA Effects:* As discussed for Alternative 1A, these impact mechanisms would not be adverse, and  
21 would typically be beneficial to Pacific lamprey.

22 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
23 mechanisms would be beneficial or less than significant, and no mitigation would be required.

24 **River Lamprey**

25 The potential effects of construction and maintenance of water conveyance facilities, operations of  
26 water conservation facilities, restoration measures and other conservation measures on river  
27 lamprey would be similar to those described under Alternative 1A.

28 **Construction and Maintenance of CM1**

29 The potential effects of construction and maintenance of water conveyance facilities on river  
30 lamprey would be similar to those described under Alternative 1A because no differences in fish  
31 effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
32 those described in detail for Alternative 1A (Impact AQUA-181 through AQUA-198), the fish effects

1 described for river lamprey under Alternative 1A also appropriately characterize effects for river  
2 lamprey under Alternative 1B.

3 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

4 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

5 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181 and AQUA-182, environmental  
6 commitments and mitigation measures would be available to avoid and minimize potential effects,  
7 and the effect would not be adverse for river lamprey.

8 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-181 and AQUA-182, the impact  
9 of the construction and maintenance of water conveyance facilities on river lamprey would be less  
10 than significant except for construction noise associated with pile driving. Implementation of  
11 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
12 less than significant.

13 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
14 **of Pile Driving and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

16 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
17 **and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

19 **Water Operations of CM1**

20 The potential effects of water conveyance facility operations on river lamprey would be similar to  
21 those described under Alternative 1A, for Impact AQUA-183 and Impact AQUA-186, which  
22 appropriately characterizes effects under Alternative 1B.

23 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

24 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
25 **River Lamprey**

26 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

27 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

28 **NEPA Effects:** As discussed in detail for Alternative 1A, the effects of Alternative 1B on river lamprey  
29 entrainment and entrainment-related predation, spawning habitat, and migration conditions would  
30 not be adverse. However, Alternative 1B operations have the potential to substantially reduce river  
31 lamprey rearing habitat, and the number of fish as a result of ammocoete mortality. These effects  
32 would be due to increased exposure to critical water temperatures in the Sacramento, Feather,  
33 American, and Stanislaus Rivers and substantial increases in exposure to flow reductions that could  
34 lead to stranding in the American River. These effects on rearing habitat would be adverse.  
35 Implementation of the mitigation measures listed below has the potential to reduce the severity of  
36 the impact, although not necessarily to a not adverse level.

1 **CEQA Conclusion:** As described above, and in detail under Alternative 1A, the CEQA analyses  
2 indicate that Alternative 1B could have significant and unavoidable effects on river lamprey rearing  
3 habitat. However, the implementation of the mitigation measures listed below also has the potential  
4 to reduce the severity of the impact though not necessarily to a not adverse or a less-than-significant  
5 level. These mitigation measures would provide an adaptive management process, that may be  
6 conducted as a part of the Adaptive Management and Monitoring Program required by the BDCP  
7 (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate minimization  
8 measures.

9 **Mitigation Measure AQUA-185a: Following Initial Operations of CM1, Conduct Additional**  
10 **Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of**  
11 **Mitigation to Reduce Impacts to Rearing Habitat**

12 Please refer to Mitigation Measure AQUA-185a under Alternative 1A (Impact AQUA-185) for  
13 river lamprey.

14 **Mitigation Measure AQUA-185b: Conduct Additional Evaluation and Modeling of Impacts**  
15 **River Lamprey Rearing Habitat Following Initial Operations of CM1**

16 Please refer to Mitigation Measure AQUA-185b under Alternative 1A (Impact AQUA-185) for  
17 river lamprey.

18 **Mitigation Measure AQUA-185c: Consult with USFWS and CDFW to Identify and**  
19 **Implement Potentially Feasible Means to Minimize Effects on River Lamprey Rearing**  
20 **Habitat Consistent with CM1**

21 Please refer to Mitigation Measure AQUA-185c under Alternative 1A (Impact AQUA-185) for  
22 river lamprey.

23 **Restoration and Conservation Measures**

24 Alternative 1B has the same restoration and conservation measures as Alternative 1A. Because no  
25 substantial differences in fish effects are anticipated anywhere in the affected environment under  
26 Alternative 1B compared to those described in detail for Alternative 1A, the effects of these  
27 measures described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact  
28 AQUA-198) also appropriately characterize effects under Alternative 1B.

29 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

30 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**  
31 **Lamprey**

32 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

33 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

34 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
35 **(CM13)**

36 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

1 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

2 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

3 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

4 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

5 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

6 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
7 **(CM21)**

8 **NEPA Effects:** As discussed in detail for Alternative 1A, the restoration and conservation measure  
9 impact mechanisms (Impact AQUA-187 through AQUA-198) have been determined to range from no  
10 effect, not adverse, or beneficial to river lamprey for NEPA purposes.

11 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
12 mechanisms would be beneficial or less than significant, and no mitigation would be required.

### 13 **Non-Covered Aquatic Species of Primary Management Concern**

14 The potential effects of construction and maintenance of water conveyance facilities, operations of  
15 water conservation facilities, restoration measures and other conservation measures on non-  
16 covered species would be similar to those described under Alternative 1A.

#### 17 **Construction and Maintenance of CM1**

18 The potential effects of construction and maintenance of water conveyance facilities on non-covered  
19 species would be similar to those described under Alternative 1A because no differences in fish  
20 effects are anticipated anywhere in the affected environment under Alternative 1B compared to  
21 those described in detail for Alternative 1A (Impact AQUA-199 through AQUA-217), the fish effects  
22 described for river lamprey under Alternative 1A also appropriately characterize effects for river  
23 lamprey under Alternative 1B.

#### 24 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered** 25 **Aquatic Species of Primary Management Concern**

#### 26 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered** 27 **Aquatic Species of Primary Management Concern**

28 **NEPA Effects:** As concluded for Alternative 1A (Impact AQUA-199 and AQUA-200), environmental  
29 commitments and mitigation measures would be available to avoid and minimize potential effects,  
30 and the effect would not be adverse for non-covered aquatic species of primary management  
31 concern.

32 **CEQA Conclusion:** As described under Alternative 1A (Impact AQUA-199 and AQUA-200), the  
33 impact of the construction and maintenance of water conveyance facilities on non-covered aquatic  
34 species of primary management concern would be less than significant except potentially for  
35 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
36 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7           **Water Operations of CM1**

8           The potential effects of water conveyance facility operations on non-covered species would be  
9           similar to those described under Alternative 1A. As no differences in effects are anticipated  
10          anywhere in the affected environment under Alternative 1B compared to those described in detail  
11          for Alternative 1A (Impact AQUA-201 through Impact AQUA-204), the effects described for non-  
12          covered aquatic species of primary management concern under Alternative 1A also appropriately  
13          characterize effects for non-covered aquatic species of primary management concern under  
14          Alternative 1B.

15          **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
16          **Species of Primary Management Concern**

17          **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
18          **Non-Covered Aquatic Species of Primary Management Concern**

19          **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**  
20          **Species of Primary Management Concern**

21          **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**  
22          **Aquatic Species of Primary Management Concern**

23          **NEPA Effects:** These impact mechanisms would not be adverse to the non-covered species of  
24          primary management concern, and with the implementation of environmental commitments and  
25          conservation measures, the effects would typically be beneficial to non-covered fish species of  
26          primary management concern.

27          **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-203  
28          and AQUA-204 could result in significant, but unavoidable effects on rearing habitat and migration  
29          habitat conditions for several fish species of primary management concern. These species include  
30          largemouth bass, Sacramento-San Joaquin roach, and hardhead. There are also no feasible  
31          mitigation measures available to mitigate for these impacts. The other impact mechanisms would be  
32          less than significant, or beneficial, so no additional mitigation would be required.

33          **Restoration and Conservation Measures**

34          Alternative 1B has the same restoration and conservation measures as Alternative 1A. Because no  
35          substantial differences in fish effects are anticipated anywhere in the affected environment under  
36          Alternative 1B compared to those described in detail for Alternative 1A, the effects of these  
37          measures described for non-covered aquatic species of primary management concern under

1 Alternative 1A (Impact AQUA-205 through Impact AQUA-216) also appropriately characterize  
2 effects under Alternative 1B.

3 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic**  
4 **Species of Primary Management Concern**

5 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**  
6 **Covered Aquatic Species of Primary Management Concern**

7 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**  
8 **Primary Management Concern**

9 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**  
10 **Primary Management Concern (CM12)**

11 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**  
12 **Aquatic Species of Primary Management Concern (CM13)**

13 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**  
14 **Species of Primary Management Concern (CM14)**

15 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**  
16 **Species of Primary Management Concern (CM15)**

17 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**  
18 **Primary Management Concern (CM16)**

19 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**  
20 **Primary Management Concern (CM17)**

21 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**  
22 **Primary Management Concern (CM18)**

23 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**  
24 **of Primary Management Concern (CM19)**

25 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
26 **Aquatic Species of Primary Management Concern (CM21)**

27 *NEPA Effects:* As discussed in detail under Alternative 1A and 6A, these impact mechanisms would  
28 not be adverse, and would typically be beneficial to non-covered fish species of primary  
29 management concern.

30 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, most of these impact  
31 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1       **Upstream Reservoirs**

2       **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

3       **NEPA Effects:** Similar to the description for Alternative 1A, Impact AQUA-217 would not be adverse  
4       because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 1B would  
5       not be substantially reduced when compared to the No Action Alternative.

6       **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 1B would reduce the  
7       quantity of coldwater fish habitat in the CVP and SWP. There would be a greater than 5% increase (5  
8       years) for several of the reservoirs, which could result in a significant impact. However, if adjusted  
9       to exclude sea level rise and climate change, Alternative 1B would not in itself result in a significant  
10      impact on coldwater habitat in upstream reservoirs. Therefore, this impact mechanism is found to  
11      be less than significant and no mitigation is required.

1 **11.3.4.4 Alternative 1C—Dual Conveyance with West Alignment and**  
2 **Intakes W1–W5 (15,000 cfs; Operational Scenario A)**

3 Alternative 1C would be nearly identical to Alternative 1A except that up to 15,000 cfs of water  
4 routed from the north Delta to the south Delta would be conveyed by gravity through a canal along  
5 the west side of the Delta instead of through pipelines/tunnels. Alternative 1C water conveyance is  
6 similar except that the route is on the west side of the Delta. Under Alternative 1C the five intakes  
7 would be constructed on the west side of the Sacramento River rather than the east side as under  
8 Alternative 1A and Alternative 1B. Similar to Alternative 1B, while there would be the same types  
9 and number of intakes, the difference in the type of conveyance facility (e.g., canal) results in  
10 different construction details to a limited extent as they relate to potential impacts on fish.  
11 Specifically, nine culvert siphons would divert canal water beneath existing water courses and their  
12 construction would occur within those water courses. Alternative 1C would also have two barge  
13 landings and 16 bridge crossings compared to six barge landings and no bridge crossings for  
14 Alternative 1A and one barge landing and 19 bridge crossings for Alternative 1B. Approximately  
15 3,000 barge trips would occur during construction. Besides the primary difference of utilizing a  
16 canal rather than a tunnel, Alternative 1C would have other structural differences such as inclusion  
17 of an intermediate pumping plant and elimination of the intermediate forebay. However, these latter  
18 differences would not affect fish resources and are not evaluated further in this chapter. Overall,  
19 construction impacts from Alternative 1C would be similar to Alternative 1A but with additional in-  
20 water work as described above. However, implementation of Mitigation Measures (described  
21 below) and Appendix 3B, *Environmental Commitments* would reduce impacts as described under  
22 Alternative 1A.

23 Water supply and conveyance operations would follow the guidelines described as Operational  
24 Scenario A, which is identical to those analyzed under Alternative 1A. CM2–CM22 would be  
25 implemented under this alternative, and these conservation measures would be identical to those  
26 under Alternative 1A. See Chapter 3, *Description of Alternatives*, for additional details on Alternative  
27 1C.

28 **Delta Smelt**

29 **Construction and Maintenance of CM1**

30 The potential effects of construction and maintenance of the water conveyance facilities on delta  
31 smelt and their designated critical habitat would be similar to those described for Alternative 1A  
32 (Impact AQUA-1 and AQUA-2) except that Alternative 1C would include five intakes on the west side  
33 compared to five intakes on the east side under Alternative 1A. The five west side intakes would  
34 have slightly larger dimensions and slightly more impact than the east side intakes. This would  
35 convert about 13,550 lineal feet of existing shoreline habitat into intake facility structures and  
36 would require about 31.1 acres of dredge and channel reshaping. In contrast, Alternative 1A would  
37 convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging.

38 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

39 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-1 and AQUA-2, the effect would not be  
2 adverse for delta smelt.

3 **CEQA Conclusion:** As described in Impact AQUA-1 and AQUA-2 under Alternative 1A for delta smelt,  
4 the impact of the construction of water conveyance facilities on delta smelt would not be significant  
5 except for construction noise associated with pile driving. Implementation of Mitigation Measure  
6 AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

7 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
8 **of Pile Driving and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

10 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
11 **and Other Construction-Related Underwater Noise**

12 **Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1. Water**  
13 **Operations of CM1**

14 Alternative 1C has the same diversion and conveyance operations as Alternative 1A. The primary  
15 difference between the two alternatives is that conveyance under Alternative 1C would be in a lined  
16 or unlined canal, instead of a pipeline. Because there would be no difference in conveyance capacity  
17 or operations, there would be no differences between these two alternatives in upstream of the  
18 Delta river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no  
19 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
20 1C compared to those described in detail for Alternative 1A (Impact AQUA-3 through AQUA-6), the  
21 fish effects described for Alternative 1A also appropriately characterize effects under Alternative 1C.

22 The following impacts are those presented under Alternative 1A that are identical for Alternative 1C.

23 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

24 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
25 **Delta Smelt**

26 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

27 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

28 **NEPA Effects:** With the exception of Impact AQUA-5, the other impact mechanisms listed above,  
29 would be beneficial or not adverse to delta smelt under Alternative 1C. This is the same conclusion  
30 as described in detail under Alternative 1A, and is based on the expected overall limited or slightly  
31 beneficial impacts. However, the overall effect of Impact AQUA-5 on delta smelt rearing habitat  
32 would remain adverse because there likely would still be a loss of suitable habitat even with BDCP  
33 restoration efforts (see Alternative 1A, AQUA-5 for details on expected effects).

34 **CEQA Conclusion:** The effects of three of the above listed impact mechanisms would be less than  
35 significant, or slightly beneficial to delta smelt, and no mitigation would be required. In addition, the  
36 effects of Impact AQUA-5 would also be considered less than significant, because it would not  
37 substantially reduce rearing habitat. Therefore, no mitigation would be required for any of the

1 impact mechanisms listed above. Detailed discussions regarding these conclusions are presented in  
2 Alternative 1A.

### 3 **Restoration and Conservation Measures**

4 Alternative 1C has the same restoration and conservation measures as Alternative 1A. Because no  
5 substantial differences in fish effects are anticipated anywhere in the affected environment under  
6 Alternative 1C compared to those described in detail for Alternative 1A, the effects described for  
7 Alternative 1A (Impact AQUA-7 through AQUA-18) also appropriately characterize effects under  
8 Alternative 1C.

9 The following impacts are those presented under Alternative 1A that are identical for Alternative 1C.

#### 10 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

#### 11 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta** 12 **Smelt**

#### 13 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

#### 14 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

#### 15 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

#### 16 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

#### 17 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

#### 18 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

#### 19 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

#### 20 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

#### 21 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

#### 22 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt** 23 **(CM21)**

24 **NEPA Effects:** As described in detail under Alternative 1A, none of these impact mechanisms  
25 (Impact AQUA-7 through AQUA-18) would be adverse to delta smelt, and most would be at least  
26 slightly beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to  
27 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on  
28 delta smelt are uncertain.

29 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or  
30 less than significant, and no mitigation is required.

1 **Longfin Smelt**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of  
3 water conservation facilities, restoration measures and other conservation measures on longfin  
4 smelt would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance of water conveyance facilities on longfin  
7 smelt would be similar to those described under Alternative 1A, because no differences in fish  
8 effects are anticipated anywhere in the affected environment under Alternative 1C compared to  
9 those described in detail for Alternative 1A (Impact AQUA-19 and AQUA-20), the effects described  
10 for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under  
11 Alternative 1C.

12 The following impacts on longfin smelt are those presented under Alternative 1A that are identical  
13 for Alternative 1C.

14 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

15 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

16 *NEPA Effects:* These impact mechanisms would not be adverse to longfin smelt. While construction  
17 activities (Impact AQUA-19) could result in adverse effects from impact pile driving activities, the  
18 implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate  
19 adverse effects from impact pile driving (e.g., injury or mortality).

20 *CEQA Conclusion:* Similar to the discussion provided above for Alternatives 1A, Impact AQUA-19  
21 could result in significant underwater noise effects from impact pile driving, although  
22 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
23 impacts to less than significant.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

30 **Water Operations of CM1**

31 The potential effects of water conveyance facility operations on longfin smelt would be similar to  
32 those described under Alternative 1A. Because no differences in fish effects are anticipated  
33 anywhere in the affected environment for Impact AQUA-21 through AQUA-24, the effects described  
34 for longfin smelt under Alternatives 1A also appropriately characterize effects under Alternative 1C.

35 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

1 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**  
2 **Habitat for Longfin Smelt**

3 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

4 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

5 **NEPA Effects:** The potential effects of water operations on longfin smelt under Alternative 1C would  
6 be similar to those described above under Alternative 1A. As discussed in detail under Impact  
7 AQUA-22 (Alternative 1A), the effect of lower Delta winter-spring outflow on longfin smelt  
8 spawning and rearing has the potential to be adverse. This effect is a result of the specific reservoir  
9 operations, exports and resulting flows associated with this alternative. However, Alternative 1C  
10 also includes an adaptive management plan that could be used to adjust spring operations as  
11 determined necessary through the adaptive management process. These adaptive management  
12 procedures are described in Mitigation Measures 22a through 22c, under Alternative 1A. The other  
13 impact mechanisms would not be adverse, and would typically be beneficial to longfin smelt.

14 **CEQA Conclusion:** As described above under Alternatives 1A, water operations under Alternative 1C  
15 would generally reduce the quantity and quality of longfin smelt rearing habitat relative to Existing  
16 Conditions. The difference in rearing habitat could be significant because Delta outflows would be  
17 reduced in the spring, which would have the potential to contribute to substantial reductions in  
18 longfin smelt abundances. These effects are due to the specific reservoir operations and resulting  
19 flows associated with this alternative. However, the implementation of Mitigation Measures AQUA-  
20 22a through 22c, habitat restoration and reduced larval entrainment would reduce this impact to  
21 less than significant, so no additional mitigation would be required.

22 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**  
23 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**  
24 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

25 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

26 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**  
27 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

28 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

29 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**  
30 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

31 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

32 **Restoration and Conservation Measures**

33 The potential effects of restoration measures and other conservation measures on longfin smelt  
34 would be similar to those described under Alternative 1A. Because no differences in fish effects are  
35 anticipated anywhere in the affected environment under Alternative 1C compared to those  
36 described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the fish effects described  
37 for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under  
38 Alternative 1C.

1 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

2 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**  
3 **Smelt**

4 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

5 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

6 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
7 **(CM13)**

8 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

9 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

10 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

11 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

12 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

13 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

14 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
15 **(CM21)**

16 **NEPA Effects:** As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these impact  
17 mechanisms have been determined to range from no effect, to not adverse, or beneficial to longfin  
18 smelt for NEPA purposes. Specifically for AQUA-26, the effects of contaminants on longfin smelt with  
19 respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of  
20 methylmercury on longfin smelt are uncertain.

21 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
22 mechanisms would be considered to range from no impact, to less than significant or beneficial for  
23 longfin smelt, and no mitigation would be required.

24 **Winter-Run Chinook Salmon**

25 The potential effects of construction and maintenance of water conveyance facilities, operations of  
26 water conservation facilities, restoration measures and other conservation measures on winter-run  
27 Chinook salmon would be similar to those described under Alternative 1A.

28 **Construction and Maintenance of CM1**

29 The potential effects of construction and maintenance of water conveyance facilities on winter-  
30 run Chinook salmon would be similar to those described under Alternative 1A because no  
31 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
32 1C compared to those described in detail for Alternative 1A (Impact AQUA-37 and AQUA-38), the  
33 fish effects described for winter-run Chinook salmon under Alternative 1A also appropriately  
34 characterize effects under Alternative 1C.

1 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
2 **(Winter-Run ESU)**

3 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
4 **(Winter-Run ESU)**

5 *NEPA Effects:* These impact mechanisms would not be adverse to winter-run Chinook salmon. While  
6 construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving  
7 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
8 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

9 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, Impact  
10 AQUA-37 could result in significant underwater noise effects from impact pile driving, although  
11 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
12 impacts to less than significant.

13 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
14 **of Pile Driving and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

16 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
17 **and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

19 **Water Operations of CM1**

20 The potential effects of operations of water conveyance facilities on winter-run Chinook salmon  
21 would be similar to those described for Alternative 1A. Because no differences in fish effects are  
22 anticipated anywhere in the affected environment under Alternative 1C compared to those  
23 described in detail for Alternative 1A (Impacts AQUA-39 through AQUA-42).

24 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**  
25 **Run ESU)**

26 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
27 **Chinook Salmon (Winter-Run ESU)**

28 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
29 **(Winter-Run ESU)**

30 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
31 **(Winter-Run ESU)**

32 *NEPA Effects:* As discussed for Alternative 1A, the impact mechanisms listed above would have  
33 significant and unavoidable adverse effects on winter-run Chinook salmon spawning, incubation,  
34 and/or rearing habitat, as well as overall migration conditions under Alternative 1C. These  
35 determinations are based on the best available scientific information at the time and may prove to  
36 have been over- or understated. The mitigation measures identified below would provide an  
37 adaptive management process, that may be conducted as a part of the Adaptive Management and

1 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing  
2 impacts and developing appropriate minimization measures. However, implementation of these  
3 measures would not necessarily result in a not adverse determination.

4 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
5 mechanisms would result in significant and unavoidable effects on winter-run Chinook salmon  
6 spawning, rearing, and migration conditions under Alternative 1C. The mitigation measures  
7 identified below would provide an adaptive management process, that may be conducted as a part  
8 of the Adaptive Management and Monitoring Program required by the BDCP (Chapter 3 of the BDCP,  
9 Section 3.6), for assessing impacts and developing appropriate minimization measures. However,  
10 the result would not necessarily result in a less than significant determination.

11 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional**  
12 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
13 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

14 Please refer to Mitigation Measure AQUA-40a under Alternative 1A (Impact AQUA-40) for  
15 winter-run Chinook salmon.

16 **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts**  
17 **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

18 Please refer to Mitigation Measure AQUA-40b under Alternative 1A (Impact AQUA-40) for  
19 winter-run Chinook salmon.

20 **Mitigation Measure AQUA-40c: Consult with USFWS and CDFW to Identify and Implement**  
21 **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Spawning**  
22 **Habitat Consistent with CM1**

23 Please refer to Mitigation Measure AQUA-40c under Alternative 1A (Impact AQUA-40) for  
24 winter-run Chinook salmon.

25 **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**  
26 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
27 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

28 Please refer to Mitigation Measure AQUA-41a under Alternative 1A (Impact AQUA-41) for  
29 winter-run Chinook salmon.

30 **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**  
31 **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

32 Please refer to Mitigation Measure AQUA-41b under Alternative 1A (Impact AQUA-41) for  
33 winter-run Chinook salmon.

34 **Mitigation Measure AQUA-41c: Consult with USFWS and CDFW to Identify and Implement**  
35 **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Rearing**  
36 **Habitat Consistent with CM1**

37 Please refer to Mitigation Measure AQUA-41c under Alternative 1A (Impact AQUA-41) for  
38 winter-run Chinook salmon.

1           **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**  
2           **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
3           **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

4           Please refer to Mitigation Measure AQUA-42a under Alternative 1A (Impact AQUA-41) for  
5           winter-run Chinook salmon.

6           **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**  
7           **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

8           Please refer to Mitigation Measure AQUA-42b under Alternative 1A (Impact AQUA-41) for  
9           winter-run Chinook salmon.

10          **Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement**  
11          **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration**  
12          **Conditions Consistent with CM1**

13          Please refer to Mitigation Measure AQUA-42c under Alternative 1A (Impact AQUA-41) for  
14          winter-run Chinook salmon.

15          **Restoration and Conservation Measures**

16          The potential effects of restoration measures and other conservation measures on winter-run  
17          Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
18          fish effects are anticipated anywhere in the affected environment under Alternative 1C compared to  
19          those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects  
20          described for winter-run Chinook salmon under Alternative 1A also appropriately characterize  
21          effects under Alternative 1C.

22          **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
23          **(Winter-Run ESU)**

24          **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
25          **Salmon (Winter-Run ESU)**

26          **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
27          **ESU)**

28          **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
29          **ESU) (CM12)**

30          **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
31          **(Winter-Run ESU) (CM13)**

32          **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
33          **Run ESU) (CM14)**

34          **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
35          **(Winter-Run ESU) (CM15)**

1 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
2 **(CM16)**

3 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
4 **(CM17)**

5 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
6 **(CM18)**

7 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
8 **ESU) (CM19)**

9 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
10 **(Winter-Run ESU) (CM21)**

11 *NEPA Effects:* As discussed in detail for Alternative 1A, the impact mechanisms listed above would  
12 not be adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for  
13 AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium,  
14 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run  
15 Chinook salmon are uncertain.

16 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
17 mechanisms would be less than significant, or beneficial, so no additional mitigation would be  
18 required.

19 **Spring-Run Chinook Salmon**

20 The potential effects of construction and maintenance of water conveyance facilities, operations of  
21 water conservation facilities, restoration measures and other conservation measures on spring-run  
22 Chinook salmon would be similar to those described under Alternative 1A.

23 **Construction and Maintenance of CM1**

24 The potential effects of construction and maintenance of water conveyance facilities on spring-  
25 run Chinook salmon would be similar to those described under Alternative 1A, because no  
26 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
27 1C compared to those described in detail for Alternative 1A (Impact AQUA-55 and AQUA-56), the  
28 fish effects described for spring-run Chinook salmon under Alternative 1A also appropriately  
29 characterize effects for spring-run Chinook salmon under Alternative 1C.

30 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
31 **(Spring-Run ESU)**

32 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
33 **(Spring-Run ESU)**

34 *NEPA Effects:* These impact mechanisms would not be adverse to spring-run Chinook salmon. While  
35 construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving  
36 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
37 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternatives 1A, Impact AQUA-55  
2 could result in significant underwater noise effects from impact pile driving, although  
3 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
4 impacts to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

11 **Water Operations of CM1**

12 The potential effects of water conveyance facility operations on spring-run Chinook salmon  
13 would be similar to those described under Alternative 1A. Because no differences in fish effects  
14 are anticipated anywhere in the affected environment under Alternative 1C compared to  
15 Alternative 1A (Impact AQUA-57 through AQUA-60).

16 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
17 **ESU)**

18 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
19 **Chinook Salmon (Spring-Run ESU)**

20 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**  
21 **Run ESU)**

22 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
23 **(Spring-Run ESU)**

24 **NEPA Effects:** As discussed in detail for Alternative 1A, the impact mechanisms listed above (except  
25 for Impact AQUA-59) would be adverse under Alternative 1C for spring-run Chinook salmon.  
26 Adverse effects would occur because entrainment, spawning and egg incubation habitat, and  
27 migration conditions for juvenile spring-run Chinook salmon would be substantially reduced, and  
28 because it has the potential to substantially increase predation and remove important instream  
29 habitat as the result of the presence of five north Delta intake structures. The implementation of  
30 conservation and mitigation measures would reduce the severity of effects, although not necessarily  
31 to a not adverse level.

32 **CEQA Conclusion:** As discussed in detail for Alternative 1A, the effects of the impact mechanisms  
33 listed above (except for Impact AQUA-59) would be significant under Alternative 1C. The effects of  
34 Alternative 1C operations on would be adverse due to predation and habitat loss associated with the  
35 five intakes of the north Delta facilities, and flow changes in the Feather River.

36 While the effect of Alternative 1C on migration conditions is adverse, the implementation of  
37 applicable conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*),  
38 as described in Chapter 3 (Section 3.6) would minimize potential effects. In addition, the

1 implementation of the mitigation measures listed below also has the potential to reduce the severity  
2 of the impact though not necessarily to a less-than-significant level. These mitigation measures  
3 would provide an adaptive management process, that may be conducted as a part of the Adaptive  
4 Management and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6),  
5 for assessing impacts and developing appropriate minimization measures.

6 **Mitigation Measure AQUA-58a: Following Initial Operations of CM1, Conduct Additional**  
7 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
8 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

9 Please refer to Mitigation Measure AQUA-58a under Alternative 1A (Impact AQUA-60) for  
10 spring-run Chinook salmon.

11 **Mitigation Measure AQUA-58b: Conduct Additional Evaluation and Modeling of Impacts**  
12 **on Spring-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

13 Please refer to Mitigation Measure AQUA-58b under Alternative 1A (Impact AQUA-60) for  
14 spring-run Chinook salmon.

15 **Mitigation Measure AQUA-58c: Consult with USFWS and CDFW to Identify and Implement**  
16 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Spawning**  
17 **Habitat Consistent with CM1**

18 Please refer to Mitigation Measure AQUA-58c under Alternative 1A (Impact AQUA-60) for  
19 spring-run Chinook salmon.

20 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**  
21 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
22 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

23 Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for  
24 spring-run Chinook salmon.

25 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**  
26 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

27 Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for  
28 spring-run Chinook salmon.

29 **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**  
30 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**  
31 **Conditions Consistent with CM1**

32 Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for  
33 spring-run Chinook salmon.

34 **Restoration and Conservation Measures**

35 The potential effects of restoration measures and other conservation measures on spring-run  
36 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
37 fish effects are anticipated anywhere in the affected environment under Alternative 1C compared to

1 those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the  
2 effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects  
3 under Alternative 1C.

4 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**  
5 **(Spring-Run ESU)**

6 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**  
7 **Salmon (Spring-Run ESU)**

8 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

9 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
10 **ESU) (CM12)**

11 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
12 **(Spring-Run ESU) (CM13)**

13 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
14 **Run ESU) (CM14)**

15 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
16 **(Spring-Run ESU) (CM15)**

17 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
18 **(CM16)**

19 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
20 **(CM17)**

21 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
22 **(CM18)**

23 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
24 **ESU) (CM19)**

25 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
26 **(Spring-Run ESU) (CM21)**

27 **NEPA Effects:** These impact mechanisms would not be adverse, and with the implementation of  
28 environmental commitments and conservation measures, the effects would typically be beneficial to  
29 spring-run Chinook salmon. Specifically for AQUA-62, the effects of contaminants on spring-run  
30 Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse.  
31 The effects of methylmercury on spring-run Chinook salmon are uncertain.

32 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, most of these impact  
33 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 1 **Fall-/Late Fall–Run Chinook Salmon**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of  
3 water conservation facilities, restoration measures and other conservation measures on fall- and  
4 late fall-run Chinook salmon would be similar to those described under Alternative 1A.

### 5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance of water conveyance facilities on fall- and  
7 late fall-run Chinook salmon would be similar to those described under Alternative 1A because  
8 no differences in fish effects are anticipated anywhere in the affected environment under  
9 Alternative 1C compared to those described in detail for Alternative 1A (Impact AQUA-73 and  
10 AQUA-74), the fish effects described for fall- and late fall-run Chinook salmon under Alternative 1A  
11 also appropriately characterize effects for fall- and late fall-run Chinook salmon under Alternative  
12 1C.

### 13 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 14 **(Fall-/Late Fall–Run ESU)**

### 15 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 16 **(Fall-/Late Fall–Run ESU)**

17 **NEPA Effects:** Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
18 would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact  
19 AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of  
20 Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from  
21 impact pile driving (e.g., injury or mortality).

22 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-73  
23 could result in significant underwater noise effects from impact pile driving, although  
24 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
25 impacts to less than significant.

### 26 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 27 **of Pile Driving and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

### 29 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 30 **and Other Construction-Related Underwater Noise**

31 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

### 32 **Water Operations of CM1**

33 The potential effects of water conveyance facility operations on fall- and late fall-run Chinook  
34 salmon would be similar to those described for Alternative 1A. Because no differences in fish effects  
35 are anticipated anywhere in the affected environment under Alternative 1C compared to those  
36 described in detail for Alternative 6A (Impacts AQUA-75 through AQUA-78).

1 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
2 **Fall-Run ESU)**

3 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
4 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

5 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
6 **(Fall-/Late Fall-Run ESU)**

7 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
8 **(Fall-/Late Fall-Run ESU)**

9 **NEPA Effects:** Overall, the effects of water operations vary by location. Similar to effects described in  
10 detail under Alternative 1A, Alternative 1C would have an adverse effect on fall-/late fall-run  
11 Chinook salmon juvenile survival because it has the potential to substantially interfere with the  
12 movement of fall-/late fall-run Chinook salmon. This would include adverse effects on fall-/late fall-  
13 run Chinook salmon through-delta migration conditions on the Sacramento River, relative to NAA,  
14 while through-Delta conditions on the San Joaquin River would be positive. The implementation of  
15 the conservation and mitigation measures listed below also has the potential to reduce the severity  
16 of the impact though not necessarily to a not adverse level.

17 **CEQA Conclusion:** Although the CEQA analyses indicate some significant effects of water operations  
18 on juvenile fall-/late fall-run Chinook salmon survival through the Delta. The implementation of  
19 applicable conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*),  
20 as described in Chapter 3 (Section 3.6) would minimize potential effects. In addition, the  
21 implementation of the mitigation measures listed below also would have the potential to reduce the  
22 severity of the effects, although not necessarily to a less-than-significant level. These mitigation  
23 measures would provide an adaptive management process, that may be conducted as a part of the  
24 Adaptive Management and Monitoring Program required by the BDCP (Chapter 3 of the BDCP,  
25 Section 3.6), for assessing impacts and developing appropriate minimization measures.

26 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
27 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
28 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

29 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for  
30 fall/late fall-run Chinook salmon.

31 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
32 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
33 **of CM1**

34 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for  
35 fall/late fall-run Chinook salmon.

1           **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
2           **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
3           **Migration Conditions Consistent with CM1**

4           Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for  
5           fall/late fall-run Chinook salmon.

6           **Restoration and Conservation Measures**

7           **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**  
8           **(Fall-/Late Fall-Run ESU)**

9           **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**  
10          **Salmon (Fall-/Late Fall-Run ESU)**

11          **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**  
12          **Run ESU)**

13          **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**  
14          **Run ESU) (CM12)**

15          **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
16          **(Fall-/Late Fall-Run ESU) (CM13)**

17          **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**  
18          **/Late Fall-Run ESU) (CM14)**

19          **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
20          **(Fall-/Late Fall-Run ESU) (CM15)**

21          **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**  
22          **Run ESU) (CM16)**

23          **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**  
24          **ESU) (CM17)**

25          **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**  
26          **ESU) (CM18)**

27          **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
28          **Fall-Run ESU) (CM19)**

29          **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
30          **(Fall-/Late Fall-Run ESU) (CM21)**

31          **NEPA Effects:** As discussed for Alternative 1A, the other impact mechanisms would not be adverse,  
32          and would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80,  
33          the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium,  
34          copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and  
35          late fall-run Chinook salmon are uncertain.

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
2 mechanisms would generally be beneficial or less than significant, and no mitigation would be  
3 required.

#### 4 **Steelhead**

5 The potential effects of construction and maintenance of water conveyance facilities, operations of  
6 water conservation facilities, restoration measures and other conservation measures on steelhead  
7 would be similar to those described under Alternative 1A.

#### 8 **Construction and Maintenance of CM1**

9 The potential effects of construction and maintenance of water conveyance facilities because no  
10 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
11 1C compared to those described in detail for Alternative 1A (Impact AQUA-91 and AQUA-92), the  
12 fish effects described for steelhead under Alternative 1A also appropriately characterize effects for  
13 steelhead under Alternative 1C.

#### 14 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

#### 15 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

16 **NEPA Effects:** These impact mechanisms would typically not be adverse to steelhead. While  
17 construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving  
18 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
19 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

20 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-91  
21 could result in significant underwater noise effects from impact pile driving, although  
22 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
23 impacts to less than significant.

#### 24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

#### 27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

#### 30 **Water Operations of CM1**

31 The potential effects of water conveyance facility operations on steelhead would be similar to those  
32 described above under Alternative 1A. Because no differences in fish effects are anticipated  
33 anywhere in the affected environment under Alternative 1C compared to those described in detail  
34 for Alternative 1A (Impact AQUA-93 through AQUA-96).

1 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

2 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
3 **Steelhead**

4 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

5 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

6 *NEPA Effects:* Collectively, these results indicate that effect is not adverse because it would not  
7 substantially reduce the amount of suitable habitat or substantially interfere with the movement of  
8 fish. Flows under Alternative 1A in each waterway examined would not be reduced enough or in  
9 high enough frequency relative to NAA to affect steelhead migration. As described in detail under  
10 Alternative 1A, these impact mechanisms would result in variable effects on steelhead, but the  
11 effects would not result in biologically meaningful reductions in overall survival of steelhead.  
12 Therefore, the effects would not be adverse to steelhead under Alternative 1C.

13 *CEQA Conclusion:* Collectively, the analysis indicates that the difference between the CEQA baseline  
14 and Alternative 1C could be significant because, under the CEQA baseline, the alternative could  
15 substantially reduce the amount of suitable habitat and interfere with steelhead migrations in some  
16 areas. Despite the variability in effects of Alternative 1C, if adjusted to exclude sea level rise and  
17 climate change, the alternative would not in itself result in a significant impact on steelhead.

18 **Restoration and Conservation Measures**

19 The potential effects of restoration and conservation measures on steelhead would be similar to  
20 those described under Alternative 1A. Because no differences in fish effects are anticipated  
21 anywhere in the affected environment under Alternative 1C, compared to those described in detail  
22 for Alternative 1A (Impact AQUA-97 through AQUA-108), the effects described for steelhead also  
23 appropriately characterize the effects under Alternative 1C.

24 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

25 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

26 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

27 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

28 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

29 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

30 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

31 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

32 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

33 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

1 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

2 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
3 **(CM21)**

4 *NEPA Effects:* As discussed for Alternative 1A, the other impact mechanisms would not be adverse,  
5 and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of contaminants  
6 on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The  
7 effects of methylmercury on steelhead are uncertain.

8 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
9 mechanisms would be beneficial or less than significant, and no mitigation would be required.

10 **Sacramento Splittail**

11 The potential effects of construction and maintenance of water conveyance facilities, operations of  
12 water conservation facilities, restoration measures and other conservation measures on Sacramento  
13 splittail would be similar to those described under Alternative 1A.

14 **Construction and Maintenance of CM1**

15 The potential effects of construction and maintenance of water conveyance facilities on  
16 Sacramento splittail would be similar to those described under Alternative 1A, because no  
17 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
18 1C compared to those described in detail for Alternative 1A (Impact AQUA-109 and AQUA-110), the  
19 fish effects described for Sacramento splittail under Alternative 1A also appropriately characterize  
20 effects for Sacramento splittail under Alternative 1C.

21 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**  
22 **Splittail**

23 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
24 **Splittail**

25 *NEPA Effects:* These impact mechanisms would generally not be adverse to Sacramento splittail.  
26 While construction activities (Impact AQUA-109) could result in adverse effects from impact pile  
27 driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
28 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

29 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-109  
30 could result in significant underwater noise effects from impact pile driving, although  
31 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
32 impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no  
33 additional mitigation would be required.

34 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
35 **of Pile Driving and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

4           **Water Operations of CM1**

5           The potential effects of water conveyance facility operations on Sacramento splittail would be  
6           similar to those described for Alternative 1A. Because no differences in fish effects are anticipated  
7           anywhere in the affected environment under Alternative 1C, compared to those described in detail  
8           for Alternative 6A (Impacts AQUA-111 through AQUA-114).

9           **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

10          **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
11          **Sacramento Splittail**

12          **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

13          **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
14          **Splittail**

15          *NEPA Effects:* As discussed in detail for Alternative 1A, the operations impact mechanisms would  
16          not be adverse to Sacramento splittail.

17          *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
18          mechanisms would be less than significant, and no mitigation would be required.

19          **Restoration and Conservation Measures**

20          The potential effects of restoration measures and other conservation measures on Sacramento  
21          splittail would be similar to those described for Alternative 1A, because no differences in fish effects  
22          are anticipated anywhere in the affected environment under Alternative 1C compared to those  
23          described in detail for Alternative 1A (Impacts AQUA-115 through AQUA-126).

24          **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

25          **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**  
26          **Sacramento Splittail**

27          **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

28          **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

29          **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**  
30          **Splittail (CM13)**

31          **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
32          **(CM14)**

1 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
2 **(CM15)**

3 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

4 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

5 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

6 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

7 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**  
8 **Splittail (CM21)**

9 *NEPA Effects:* As discussed for Alternative 1A, the other impact mechanisms would not be adverse,  
10 and would typically be beneficial to Sacramento splittail. Specifically for AQUA-116, the effects of  
11 contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides  
12 would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

13 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
14 mechanisms would be beneficial or less than significant, and no mitigation would be required.

15 **Green Sturgeon**

16 The potential effects of construction and maintenance of water conveyance facilities, operations of  
17 water conservation facilities, restoration measures and other conservation measures on green  
18 sturgeon would be similar to those described under Alternative 1A.

19 **Construction and Maintenance of CM1**

20 The potential effects of construction and maintenance of water conveyance facilities on green  
21 sturgeon would be similar to those described under Alternative 1A, because no differences in  
22 fish effects are anticipated anywhere in the affected environment under Alternative 1C compared to  
23 those described in detail for Alternative 1A (Impact AQUA-127 through AQUA-144).

24 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

25 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

26 *NEPA Effects:* While the maintenance impact mechanism (Impact AQUA-128) would not be adverse  
27 to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from  
28 impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and  
29 AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or  
30 mortality).

31 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-127  
32 could result in significant underwater noise effects from impact pile driving, although  
33 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
34 impacts to less than significant. The other impact mechanism would be less than significant, so no  
35 additional mitigation would be required.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

7           **Water Operations of CM1**

8           The potential effects of operations of water conveyance facilities on green sturgeon would be similar  
9           to those described for Alternative 1A. Because no differences in fish effects are anticipated  
10          anywhere in the affected environment under Alternative 1C compared to those described in detail  
11          for Alternative 1A (Impacts AQUA-129 through AQUA-132), the effects described for green sturgeon  
12          also appropriately characterize the effects under Alternative 1C.

13          **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

14          **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
15          **Green Sturgeon**

16          **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

17          **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

18          *NEPA Effects:* As discussed for Alternative 1A, Impact AQUA-132 is expected to negatively affect  
19          green sturgeon migration conditions under Alternative 1C. These effects are a result of the specific  
20          reservoir operations and resulting flows associated with this alternative. The implementation of the  
21          mitigation measures listed below has the potential to reduce the severity of the impact, although not  
22          necessarily to a level considered not adverse.

23          *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-132,  
24          the migration habitat conditions under Alternative 1C would be negatively affected, compared to  
25          Existing Conditions. The implementation of the mitigation measures listed below has the potential  
26          to reduce the severity of the impact, although not necessarily to a less-than-significant level. These  
27          mitigation measures would provide an adaptive management process, that may be conducted as a  
28          part of the Adaptive Management and Monitoring Program required by the BDCP (Chapter 3 of the  
29          BDCP, Section 3.6), for assessing impacts and developing appropriate minimization measures.

30          **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**  
31          **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**  
32          **Mitigation to Reduce Impacts to Migration Conditions**

33          Please refer to Mitigation Measure AQUA-132a under Alternative 1A (Impact AQUA-132) for  
34          green sturgeon.

1           **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
2           **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

3           Please refer to Mitigation Measure AQUA-132b under Alternative 1A (Impact AQUA-132) for  
4           green sturgeon.

5           **Mitigation Measure AQUA-132c: Consult with USFWS and CDFW to Identify and**  
6           **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
7           **Conditions Consistent with CM1**

8           Please refer to Mitigation Measure AQUA-132c under Alternative 1A (Impact AQUA-132) for  
9           green sturgeon.

10          **Restoration and Conservation Measures**

11          Alternative 1C has the same restoration and conservation measures as Alternative 1A. Because no  
12          substantial differences in fish effects are anticipated anywhere in the affected environment under  
13          Alternative 1C compared to those described in detail for Alternative 1A, the effects of the restoration  
14          and conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-133  
15          through Impact AQUA-144) also appropriately characterize effects under Alternative 1C.

16          **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

17          **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**  
18          **Sturgeon**

19          **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

20          **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

21          **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
22          **(CM13)**

23          **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

24          **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
25          **(CM15)**

26          **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

27          **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

28          **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

29          **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

30          **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
31          **Sturgeon (CM21)**

32          **NEPA Effects:** As discussed for Alternative 1A, these impact mechanisms would not be adverse, and  
33          with the implementation of environmental commitments and conservation measures, the effects

1 would typically be beneficial to green sturgeon. Specifically for AQUA-134, the effects of  
2 contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be  
3 adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

4 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
5 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 6 **White Sturgeon**

7 The potential effects of construction and maintenance of water conveyance facilities, operations of  
8 water conservation facilities, restoration measures and other conservation measures on white  
9 sturgeon would be similar to those described under Alternative 1A.

### 10 **Construction and Maintenance of CM1**

11 The potential effects of construction and maintenance of water conveyance facilities on white  
12 sturgeon would be similar to those described under Alternative 1A, because no differences in  
13 fish effects are anticipated anywhere in the affected environment under Alternative 1C compared to  
14 those described in detail for Alternative 1A (Impact AQUA-145 and AQUA-146). Therefore, the  
15 effects described for white sturgeon under Alternative 1A also appropriately characterize effects for  
16 white sturgeon under Alternative 1C.

### 17 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

### 18 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

19 **NEPA Effects:** As concluded for Alternative 1A (Impact AQUA-145 and AQUA-146), environmental  
20 commitments and mitigation measures would be available to avoid and minimize potential effects,  
21 so the effect would not be adverse for white sturgeon.

22 **CEQA Conclusion:** As described under Alternative 1A (Impact AQUA-145 and AQUA-146), the  
23 impact of the construction and maintenance of water conveyance facilities on white sturgeon would  
24 be less than significant except for construction noise associated with pile driving. Implementation of  
25 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
26 less than significant.

#### 27 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 28 **of Pile Driving and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

#### 30 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 31 **and Other Construction-Related Underwater Noise**

32 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

### 33 **Water Operations of CM1**

34 The potential effects of operations of water conveyance facilities on white sturgeon would be similar  
35 to those described for Alternative 1A. Because no differences in fish effects are anticipated  
36 anywhere in the affected environment under Alternative 1C compared to those described in detail

1 for Alternative 1A (Impacts AQUA-147 through AQUA-150), the effects described for white sturgeon  
2 also appropriately characterize the effects under Alternative 1C.

3 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

4 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
5 **White Sturgeon**

6 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

7 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

8 **NEPA Effects:** As described in detail under Alternatives 1A, the effects of water operations on white  
9 sturgeon would generally not be adverse. However, uncertainty regarding the mechanisms  
10 responsible for the positive correlation between year class strength and high river/Delta flow would  
11 be addressed through targeted research and monitoring, prior to the initiation of north Delta  
12 facilities operations. If these targeted investigations determine that the primary mechanism behind  
13 the positive correlation are related to in-Delta and through-Delta flow conditions, Alternative 1C  
14 operations would be considered to be adverse.

15 **CEQA Conclusion:** While the effects of Alternative 1C would not be significant for entrainment and  
16 spawning habitat, the results of the Impact AQUA-149 and AQUA-150 analyses indicate that the  
17 difference between the CEQA baseline and Alternative 1C could be significant, but the differences  
18 would generally be due to climate change, sea level rise, and future demand, and not the alternative.  
19 As a result, the CEQA conclusion regarding Alternative 1C, if adjusted to exclude sea level rise and  
20 climate change would be less than significant, and no mitigation is required.

21 **Restoration and Conservation Measures**

22 Alternative 1C has the same restoration and conservation measures as Alternative 1A. Because no  
23 substantial differences in fish effects are anticipated anywhere in the affected environment under  
24 Alternative 1C, compared to those described in detail for Alternative 1A, the effects of these  
25 measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact  
26 AQUA-162) also appropriately characterize effects under Alternative 1C.

27 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

28 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**  
29 **Sturgeon**

30 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

31 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

32 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**  
33 **(CM13)**

34 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

1 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**  
2 **(CM15)**

3 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

4 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

5 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

6 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

7 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**  
8 **Sturgeon (CM21)**

9 *NEPA Effects:* As described for Alternative 1A, these impact mechanisms would not be adverse to  
10 white sturgeon. Specifically for AQUA-152, the effects of contaminants on white sturgeon with  
11 respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and  
12 selenium on white sturgeon are uncertain.

13 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
14 mechanisms would be beneficial or less than significant, and no mitigation would be required.

15 **Pacific Lamprey**

16 The potential effects of construction and maintenance of water conveyance facilities, operations of  
17 water conservation facilities, restoration measures and other conservation measures on Pacific  
18 lamprey would be similar to those described under Alternative 1A.

19 **Construction and Maintenance of CM1**

20 The potential effects of construction and maintenance of water conveyance facilities because no  
21 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
22 1C compared to those described in detail for Alternative 1A (Impact AQUA-163 and AQUA-164), the  
23 effects described for Pacific lamprey under Alternative 1A also appropriately characterize effects for  
24 Pacific lamprey under Alternative 1C.

25 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

26 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

27 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-163 and AQUA-164, environmental  
28 commitments and mitigation measures would be available to avoid and minimize potential effects,  
29 and the effect would not be adverse for Pacific lamprey.

30 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-163 and AQUA-164, the impact  
31 of the construction and maintenance of water conveyance facilities on Pacific lamprey would be less  
32 than significant except for construction noise associated with pile driving. Implementation of  
33 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
34 less than significant.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7           **Water Operations of CM1**

8           The potential effects of water conveyance facility operations on Pacific lamprey would be similar to  
9           those described under Alternative 1A. Because no differences in fish effects are anticipated  
10          anywhere in the affected environment under Alternative 1C compared to those described in detail  
11          for Alternative 1A (Impact AQUA-165 and Impact AQUA-168)

12          **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

13          **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
14          **Pacific Lamprey**

15          **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

16          **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

17          **NEPA Effects:** Similar to the results discussed in detail under Alternative 1A, effects on entrainment  
18          of Pacific lamprey would not be adverse, and could be beneficial, due to design, installation, and  
19          operation of new screens in the north Delta. However, flow reductions are expected to cause  
20          substantial reductions in habitat available for spawning and egg incubation in the Feather River, and  
21          reduce overall spawning success. While the implementation of the mitigation measures listed below  
22          (Mitigation Measures AQUA-166a through AQUA-166c) would reduce the severity of effects, this  
23          would not necessarily result in a not adverse determination. However, the changes in flow would  
24          not substantially interfere with the movement of fish.

25          **CEQA Conclusions:** As concluded under Alternative 1A, Alternative 1C water operations could  
26          substantially reduce the number of fish as a result of increased exposure to redd dewatering and  
27          elevated water temperatures, which would reduce egg survival and increase ammocoete mortality.  
28          While the implementation of the mitigation measures listed below (Mitigation Measures AQUA-166a  
29          through AQUA-166c) would reduce the severity of effects, this would not necessarily result in a less  
30          than significant determination.

31          **Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional**  
32          **Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of**  
33          **Mitigation to Reduce Impacts to Spawning Habitat**

34          Please refer to Mitigation Measure AQUA-166a under Impact AQUA-166 of Alternative 1A.

1           **Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts**  
2           **on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1**

3           Please refer to Mitigation Measure AQUA-166b under Impact AQUA-166 of Alternative 1A.

4           **Mitigation Measure AQUA-166c: Consult with USFWS and CDFW to Identify and**  
5           **Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning**  
6           **Habitat Consistent with CM1**

7           Please refer to Mitigation Measure AQUA-166c under Impact AQUA-166 of Alternative 1A.

8           **Restoration and Conservation Measures**

9           Alternative 1C has the same restoration and conservation measures as Alternative 1A. Because no  
10          substantial differences in fish effects are anticipated anywhere in the affected environment under  
11          Alternative 1C compared to those described in detail for Alternative 1A, the effects of these  
12          measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact  
13          AQUA-180) also appropriately characterize effects under Alternative 1C.

14          **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

15          **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**  
16          **Lamprey**

17          **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

18          **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

19          **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**  
20          **(CM13)**

21          **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

22          **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**  
23          **(CM15)**

24          **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

25          **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

26          **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

27          **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

28          **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
29          **Lamprey (CM21)**

30          **NEPA Effects:** As discussed for Alternative 1A, these impact mechanisms would not be adverse, and  
31          would typically be beneficial to Pacific lamprey.

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
2 mechanisms would be beneficial or less than significant, and no mitigation would be required.

### 3 **River Lamprey**

4 The potential effects of construction and maintenance of water conveyance facilities, operations of  
5 water conservation facilities, restoration measures and other conservation measures on river  
6 lamprey would be similar to those described under Alternative 1A.

### 7 **Construction and Maintenance of CM1**

8 The potential effects of construction and maintenance of water conveyance facilities on river  
9 lamprey would be similar to those described under Alternative 1A because no differences in fish  
10 effects are anticipated anywhere in the affected environment under Alternative 1C compared to  
11 those described in detail for Alternative 1A (Impact AQUA-181 and AQUA-182)., As a result, the fish  
12 effects described for river lamprey under Alternative 1A also appropriately characterize effects for  
13 river lamprey under Alternative 1C.

### 14 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

### 15 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

16 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181 and AQUA-182, environmental  
17 commitments and mitigation measures would be available to avoid and minimize potential effects,  
18 and the effect would not be adverse for river lamprey.

19 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-181 and AQUA-182, the impact  
20 of the construction and maintenance of water conveyance facilities on river lamprey would be less  
21 than significant except for construction noise associated with pile driving. Implementation of  
22 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
23 less than significant.

### 24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

### 27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

### 30 **Water Operations of CM1**

31 The potential effects of water conveyance facility operations on river lamprey would be similar to  
32 those described under Alternative 1A. Because no differences in fish effects are anticipated  
33 anywhere in the affected environment under Alternative 1C, compared to those described in detail  
34 for Alternative 1A (Impact AQUA-183 through Impact AQUA-186). Therefore, the effects described  
35 for river lamprey under Alternative 6A also appropriately characterize effects under Alternative 1C.

### 36 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

1 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **River Lamprey**

3 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

4 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

5 **NEPA Effects:** As discussed in detail for Alternative 1A, the effects of water operations under  
6 Alternative 1C has the potential to substantially reduce river lamprey rearing habitat, and  
7 substantially reduce the number of fish as a result of ammocoete mortality. However, the  
8 implementation of the mitigation measures listed below has the potential to reduce the severity of  
9 the impact, although not necessarily to a not adverse level. Therefore, the impact is considered  
10 adverse.

11 **CEQA Conclusion:** As described in detail under Alternative 1A, the CEQA analyses indicate that  
12 water operations under Alternative 1C has the potential to significantly reduce river lamprey  
13 rearing habitat, as well as the number of fish as a result of ammocoete mortality. While the  
14 implementation of the mitigation measures listed below has the potential to reduce the severity of  
15 the impact, it would not necessarily reduce it to a less-than-significant level. These mitigation  
16 measures would provide an adaptive management process, that may be conducted as a part of the  
17 Adaptive Management and Monitoring Program required by the BDCP (Chapter 3 of the BDCP,  
18 Section 3.6), for assessing impacts and developing appropriate minimization measures.

19 **Mitigation Measure AQUA-185a: Following Initial Operations of CM1, Conduct Additional**  
20 **Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of**  
21 **Mitigation to Reduce Impacts to Rearing Habitat**

22 Please refer to Mitigation Measure AQUA-185a under Alternative 1A (Impact AQUA-185) for  
23 river lamprey.

24 **Mitigation Measure AQUA-185b: Conduct Additional Evaluation and Modeling of Impacts**  
25 **River Lamprey Rearing Habitat Following Initial Operations of CM1**

26 Please refer to Mitigation Measure AQUA-185b under Alternative 1A (Impact AQUA-185) for  
27 river lamprey.

28 **Mitigation Measure AQUA-185c: Consult with USFWS and CDFW to Identify and**  
29 **Implement Potentially Feasible Means to Minimize Effects on River Lamprey Rearing**  
30 **Habitat Consistent with CM1**

31 Please refer to Mitigation Measure AQUA-185c under Alternative 1A (Impact AQUA-185) for  
32 river lamprey.

33 **Restoration and Conservation Measures**

34 Alternative 1C has the same restoration and conservation measures as Alternative 1A. Because no  
35 substantial differences in fish effects are anticipated anywhere in the affected environment under  
36 Alternative 1C compared to those described in detail for Alternative 1A, the effects of the measures  
37 described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-198)  
38 also appropriately characterize effects under Alternative 1C.

1 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

2 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**  
3 **Lamprey**

4 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

5 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

6 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
7 **(CM13)**

8 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

9 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

10 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

11 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

12 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

13 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

14 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
15 **(CM21)**

16 **NEPA Effects:** As discussed for Alternative 1A, the other impact mechanisms would not be adverse,  
17 and would typically be beneficial to river lamprey.

18 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
19 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 20 **Non-Covered Aquatic Species of Primary Management Concern**

21 The potential effects of construction and maintenance of water conveyance facilities, operations of  
22 water conservation facilities, restoration measures and other conservation measures on non-  
23 covered species would be similar to those described under Alternative 1A.

### 24 **Construction and Maintenance of CM1**

25 The potential effects of construction and maintenance activities on non-covered aquatic species of  
26 primary management concern would be similar to those described under Alternative 1A because no  
27 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
28 1C compared to those described in detail for Alternative 1A (Impact AQUA-199 through AQUA-217).  
29 Therefore, the fish effects described for non-covered aquatic species of primary management  
30 concern under Alternative 1A also appropriately characterize effects for river lamprey under  
31 Alternative 1C.

1 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**  
2 **Aquatic Species of Primary Management Concern**

3 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
4 **Aquatic Species of Primary Management Concern**

5 *NEPA Effects:* As concluded for Alternative 1A (Impact AQUA-199 and AQUA-200), environmental  
6 commitments and mitigation measures would be available to avoid and minimize potential effects,  
7 and the effect would not be adverse for non-covered aquatic species of primary management  
8 concern.

9 *CEQA Conclusion:* As described under Alternative 1A (Impact AQUA-199 and AQUA-200), the  
10 impact of the construction and maintenance of water conveyance facilities on non-covered aquatic  
11 species of primary management concern would be less than significant except potentially for  
12 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
13 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

14 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
15 **of Pile Driving and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

17 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
18 **and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

20 **Water Operations of CM1**

21 The potential effects of water conveyance facility operations on non-covered aquatic species of  
22 primary management concern would be similar to those described under Alternative 1A, because no  
23 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
24 1C compared to those described in detail for Alternative 1A (Impact AQUA-201 through Impact  
25 AQUA-204).

26 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
27 **Species of Primary Management Concern**

28 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
29 **Non-Covered Aquatic Species of Primary Management Concern**

30 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**  
31 **Species of Primary Management Concern**

32 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**  
33 **Aquatic Species of Primary Management Concern**

34 *NEPA Effects:* These impact mechanisms would not be adverse to the non-covered species of  
35 primary management concern, as well as with the implementation of environmental commitments  
36 and conservation measures, the effects would typically be beneficial.

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
2 mechanisms would generally be less than significant. However, Impact AQUA-203 and AQUA-204  
3 could result in significant, but unavoidable effects on rearing habitat and migration habitat  
4 conditions for several fish species. These species include largemouth bass, Sacramento-San Joaquin  
5 roach, and hardhead. There are also no feasible mitigation measures available to mitigate for these  
6 impacts. The other impact mechanisms would be less than significant, or beneficial, so no additional  
7 mitigation would be required.

## 8 **Restoration and Conservation Measures**

9 Alternative 1C has the same restoration and conservation measures as Alternative 1A. Because no  
10 substantial differences in fish effects are anticipated anywhere in the affected environment under  
11 Alternative 1C compared to those described in detail for Alternative 1A, the effects of these  
12 measures described for non-covered aquatic species of primary management concern under  
13 Alternative 1A (Impact AQUA-205 through Impact AQUA-216) also appropriately characterize  
14 effects under Alternative 1C.

### 15 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic 16 Species of Primary Management Concern**

### 17 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non- 18 Covered Aquatic Species of Primary Management Concern**

### 19 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of 20 Primary Management Concern**

### 21 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of 22 Primary Management Concern (CM12)**

### 23 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered 24 Aquatic Species of Primary Management Concern (CM13)**

### 25 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic 26 Species of Primary Management Concern (CM14)**

### 27 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic 28 Species of Primary Management Concern (CM15)**

### 29 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of 30 Primary Management Concern (CM16)**

### 31 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of 32 Primary Management Concern (CM17)**

### 33 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of 34 Primary Management Concern (CM18)**

### 35 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species 36 of Primary Management Concern (CM19)**

1 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
2 **Aquatic Species of Primary Management Concern (CM21)**

3 **NEPA Effects:** As discussed in detail under Alternative 1A, these impact mechanisms would not  
4 adversely affect the aquatic species of primary management concern, and with the implementation  
5 of environmental commitments and conservation measures, the effects would typically be beneficial.

6 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
7 mechanisms would be beneficial or less than significant, and no mitigation would be required.

8 **Upstream Reservoirs**

9 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

10 **NEPA Effects:** As discussed in detail under Alternative 1A, this effect would not be adverse because  
11 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 1C would not be  
12 substantially reduced when compared to the No Action Alternative.

13 **CEQA Conclusion:** In general, as discussed under Alternative 1A, Alternative 1C would reduce the  
14 quantity of coldwater fish habitat in the CVP and SWP compared to Existing Conditions, which could  
15 result in a significant impact. However, if adjusted to exclude sea level rise and climate change,  
16 Alternative 1C would not in itself result in a significant impact on coldwater habitat in upstream  
17 reservoirs. Therefore, this impact is found to be less than significant and no mitigation is required.

1 **11.3.4.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five**  
2 **Intakes (15,000 cfs; Operational Scenario B)**

3 Like Alternative 1A, Alternative 2A would consist of pipelines and tunnels generally located in the  
4 central Delta with an intermediate forebay; however, Alternative 2A could potentially entail two  
5 different intake and intake pumping plant locations. Currently, as an alternative to Intakes 1–5,  
6 intake locations 1, 2, 3, 6, and 7 are being considered. Selection of intake locations 6 and 7 would  
7 entail construction in the same general region (north Delta), although about 5 and 6 miles farther  
8 downstream from the Intake 5 location, respectively. Thus, the same types of construction effects on  
9 fish species would occur, as those discussed for Alternative 1A. In addition, some of the conveyance  
10 pipelines and the initial tunnel (Tunnel 1) between the intake pumping plants and the intermediate  
11 forebay would be adjusted depending on the intake locations. This alternative would convey water  
12 from five fish-screened intakes between Clarksburg and Walnut Grove (Intakes 6 and 7, if selected,  
13 would be downstream of Sutter and Steamboat Sloughs) to a new Byron Tract Forebay adjacent to  
14 CCF. Construction effects for all fish species would be similar to those described for Alternative 1A.

15 Like Alternative 1A, the Alternative 2A facilities could convey up to 15,000 cfs from the north Delta,  
16 although Alternative 2A water conveyance operational criteria (Operational Scenario B) would be  
17 modified from those described for Alternative 1A (Operational Scenario A). Unlike Operational  
18 Scenario A, Operational Scenario B includes incorporation of Fall X2 guidelines, more restrictive  
19 (less negative) south Delta OMR flows, and an operable barrier at the head of Old River (see Section  
20 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*). Operational Scenario B  
21 also includes north Delta diversion bypass flow criteria, south Delta export/inflow ratio, flow  
22 criteria over Fremont Weir into Yolo Bypass, Delta inflow and outflow criteria, DCC gate operations,  
23 Rio Vista minimum instream flow criteria, operations for Delta water quality and residence criteria,  
24 and water quality criteria for agricultural and municipal/industrial diversions.

25 **Delta Smelt**

26 **Construction and Maintenance of CM1**

27 Small numbers of delta smelt eggs, larvae, and/or adults could be present in the Delta in June and  
28 July during construction of intake facilities and the barge landings (see Table 11-6). The  
29 construction and maintenance sites also occur entirely within designated delta smelt critical habitat.

30 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

31 The potential effects of construction of the water conveyance facilities on delta smelt or designated  
32 critical habitat would be similar to those described for Alternative 1A (Impact AQUA-1) except that  
33 Alternative 2A could potentially include two different intakes than under Alternative 1A. This would  
34 convert about 11,350 lineal feet of existing shoreline habitat into intake facility structures and  
35 would require about 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would  
36 convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. The effects related  
37 to temporary increases in turbidity, accidental spills, underwater noise, in-water work activities,  
38 and disturbance of contaminated sediments would be similar to Alternative 1A and the same  
39 environmental commitments and mitigation measures (described under Impact AQUA-1 for delta  
40 smelt and in Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize  
41 potential effects.

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-1, the effect would not be adverse for  
2 delta smelt or designated critical habitat.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-1, the impact of the construction of  
4 water conveyance facilities on delta smelt and critical habitat would be less than significant with the  
5 implementation measures described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
6 *Environmental Commitments*, except for construction noise associated with pile driving.  
7 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce  
8 that noise impact to less than significant.

9 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
10 **of Pile Driving and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

12 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
13 **and Other Construction-Related Underwater Noise**

14 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

15 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

16 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
17 Alternative 2A would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
18 AQUA-2). As concluded in Alternative 1A, Impact AQUA-2, with the implementation measures  
19 described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*,  
20 the effect would not be adverse for delta smelt.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-2, with the implementation  
22 measures described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental*  
23 *Commitments*, the impact of the maintenance of water conveyance facilities on delta smelt would be  
24 less than significant and no mitigation is required.

25 **Water Operations of CM1**

26 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

27 ***Water Exports from SWP/CVP South Delta Facilities***

28 Overall, operational activities under Alternative 2A would benefit delta smelt by reducing average  
29 proportional entrainment at the south Delta facilities. Average juvenile proportional entrainment  
30 (March–June) would be 0.14 (i.e., 14% of the juvenile population) under Alternative 2A, which  
31 would be reduced 0.008 (a 5% relative decrease) compared to baseline (0.15 NAA) (Figure 11-2A-1,  
32 Table 11-2A-1). As described under Alternative 1A (Impact AQUA-3), the greatest relative  
33 reductions in larval/juvenile proportional entrainment would be in wetter years (24% to 33%  
34 relative decrease compared to NAA). Average adult proportional entrainment (December–March)  
35 for all water year types would be reduced under Alternative 2A by 0.02 (a 27% relative decrease)  
36 under Alternative 2A compared to NAA (Figure 11-2A-2, Table 11-2A-1).

1 **Table 11-2A-1. Differences in Proportional Entrainment of Delta Smelt at SWP/CVP South Delta**  
2 **Facilities**

Water Year Type	Proportional Entrainment <sup>a</sup>	
	Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A2A	NAA vs. A2A
<b>Total Population</b>		
Wet	-0.034 (-31%)	-0.059 (-44%)
Above Normal	-0.028 (-17%)	-0.056 (-29%)
Below Normal	0.016 (7%)	-0.013 (-5%)
Dry	0.017 (6%)	-0.002 (-1%)
Critical	0.010 (3%)	0.010 (3%)
All Years	-0.007 (-3%)	-0.028 (-13%)
<b>Juvenile Delta Smelt (March–June)</b>		
Wet	0.005 (13%)	-0.021 (-33%)
Above Normal	0.002 (3%)	-0.027 (-24%)
Below Normal	0.030 (22%)	-0.001 (-1%)
Dry	0.026 (14%)	0.005 (3%)
Critical	0.017 (7%)	0.012 (5%)
All Years	0.015 (12%)	-0.008 (-5%)
<b>Adult Delta Smelt<sup>b</sup> (December–March)</b>		
Wet	-0.039 (-56%)	-0.038 (-55%)
Above Normal	-0.030 (-37%)	-0.029 (-36%)
Below Normal	-0.014 (-17%)	-0.012 (-15%)
Dry	-0.009 (-11%)	-0.007 (-9%)
Critical	-0.007 (-9%)	-0.002 (-2%)
All Years	-0.022 (-29%)	-0.020 (-27%)
Shading indicates >5% or more increased entrainment.		
Note: Negative values indicate lower entrainment loss under Alternative 2A than under EXISTING CONDITIONS.		
<sup>a</sup> Proportional entrainment index (U.S. Fish and Wildlife Service 2008a).		
<sup>b</sup> Adult proportional entrainment adjusted according to Kimmerer (2011).		

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 As described for Alternative 1A (Impact AQUA-3 for delta smelt), delta smelt would face potential  
6 entrainment and impingement at the proposed north Delta diversion facilities. The exposure to  
7 potential entrainment would be low, however, because only a very small proportion of the  
8 population occurs at this location. The intakes would be screened to exclude fish larger than 15 mm  
9 SL, which would include juvenile delta smelt. There would be potential negative effects from  
10 entrainment of smaller life stages (eggs and larvae) and potential impingement and screen contact  
11 by juveniles and adults (Appendix B, *Entrainment*, Section B.6.2.3).

**Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

As described for Alternative 1A, potential entrainment and impingement risks at the north Delta intakes would be limited since delta smelt rarely occur in the vicinity of the proposed intake site. Potential larval smelt entrainment as modeled by PTM would be minimal (less than 2% under Alternative 2A) and similar to NAA. The intake would be screened to exclude fish larger than 15 mm SL.

**Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

Potential entrainment of larval delta smelt at the NBA, as estimated by particle-tracking models was low, averaging 1.3% under Alternative 2A compared to 2.0% under NAA, a 35% reduction in relative terms (Table 11-2A-2).

**Table 11-2A-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 2A and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A2A_LL	A2A_LL vs. EXISTING CONDITIONS	A2A_LL vs. NAA
2.1	2.0	1.3	-0.81 (-39%)	-0.71 (-35%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario.

**Predation Associated with Entrainment**

As described in Impact AQUA-3 for Alternative 1A, pre-screen losses of delta smelt at the SWP/CVP facilities are believed to be high and are typically attributed to predation and other unfavorable conditions near the pumps (Castillo et al. 2012). Under Alternative 2, pre-screen losses at the south Delta facilities would decrease commensurate with entrainment reductions described above. Structures associated with the proposed north Delta intakes could attract piscivorous fish, potentially increasing localized predation risk. However few delta smelt would be expected to occur in the vicinity of the north Delta intakes, thus limiting their exposure to the predation risk. Predatory fish could potentially occur along NPBs, which could potentially increase predation risk at those times of year delta smelt are in that region of the south Delta (December–June). The effect would be beneficial for delta smelt because fewer delta smelt would be lost to predation across all SWP/CVP facilities.

**NEPA Effects:** Under Alternative 2A, overall potential entrainment of delta smelt would be reduced at the south Delta SWP/CVP facilities. Entrainment and impingement could potentially occur at the proposed north Delta intakes, but the risk would be low due to the location, design and operation of intakes, and offset by reduced entrainment at the south Delta facilities. Furthermore, any potential effects would be reduced by monitoring and adaptive management by the Real-Time Response Team. Overall, Alternative 2A would not have an adverse effect and may be beneficial to delta smelt due to a small reduction in entrainment and associated predation losses at the south Delta facilities, and minimizing entrainment at the north Delta facilities and NBA intakes.

**CEQA Conclusion:** As described above, operations under Alternative 2A would reduce average adult proportional entrainment by 0.022 (a 29% relative decrease) compared to Existing Conditions.

1 Larval/juvenile entrainment would increase by 0.015 (12% relative increase) on average, and  
2 increase by 0.030 (22% relative increase) in below normal years compared to Existing Conditions  
3 (Table 11-2A-1). However, this would affect a small proportion of the population (1.5% on average,  
4 3% in below normal years).

5 This CEQA interpretation of the biological modeling differs from the NEPA analysis, which is likely  
6 attributable to different modeling assumptions (as described fully in Section 11.3.3 and Alternative  
7 1A Impact AQUA-3). Because the action alternative modeling does not partition the effects of  
8 implementation of the alternative from the effects of sea level rise, climate change and future water  
9 demands, the comparison to Existing Conditions may not offer a clear understanding of the impact  
10 of the alternative on the environment. Note that the analysis for larvae and juveniles includes both  
11 OMR flows and X2 as predictors of proportional entrainment; primarily because of sea level rise  
12 assumptions, X2 would be further upstream in the ELT and LLT even with similar water operations,  
13 so that the comparison of the action alternative in the ELT and LLT to Existing Conditions is  
14 confounded.

15 Therefore, the impact analysis is better informed by the results from the NEPA analysis presented  
16 above, which accounts for sea level rise by considering the NAA in the LLT. When climate change is  
17 factored in, larval-juvenile delta smelt proportional entrainment is reduced 0.008 (5% relative  
18 decrease) on average compared to conditions without BDCP, and is similar in below normal years  
19 (Table 11-2A-1).

20 The risk of entrainment and impingement at the proposed north Delta intakes is low due to the low  
21 abundance of delta smelt in the vicinity, and would be further minimized by fish screens. Potential  
22 entrainment of larvae would be slightly decreased (~1%) at the NBA (Table 11-2A-2).

23 Overall, Alternative 2A would not significantly increase entrainment and associated predation losses  
24 at the south Delta facilities, and would minimize entrainment at the north Delta facilities and NBA  
25 intakes. Furthermore, any potential impacts would be reduced by monitoring and adaptive  
26 management by the Real-Time Response Team. The impact is considered to be less than significant,  
27 and no mitigation would be required.

#### 28 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 29 **Delta Smelt**

30 **NEPA Effects:** The effects of operations under Alternative 2A on abiotic spawning habitat would be  
31 about the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north  
32 Delta intakes would not reduce available spawning habitat. In-Delta water temperatures, which can  
33 affect spawning timing, would not change across Alternatives, because they would be in thermal  
34 equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect  
35 of Alternative 2A operations on spawning would not be adverse, because there would be little  
36 change in abiotic spawning conditions for delta smelt.

37 **CEQA Conclusion:** As described above, operations under Alternative 2A would not reduce abiotic  
38 spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the  
39 impact would be less than significant, and no mitigation is required.

#### 40 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

41 As described for Alternative 1A (Impact AQUA-5 for delta smelt), rearing habitat conditions for  
42 juvenile delta smelt were evaluated using the fall abiotic habitat index (Feyrer et al. 2011) with and

without the assumption that habitat benefits are realized. Unlike Alternative 1A, Alternative 2A includes the BiOp Fall X2 requirements. The abiotic habitat index under Alternative 2A without restoration would be similar to NAA (Table 11-2A-3, Figure 11-2A-3). However, Alternative 2A is expected to further benefit delta smelt by habitat restoration (*CM2 Yolo Bypass Fisheries Enhancement and CM4 Tidal Natural Communities Restoration*), particularly in the Suisun Marsh, West Delta, and Cache Slough ROAs, which are closer to delta smelt’s main areas of occurrence. Habitat restoration, similar in scale to that under Alternative 1A, is expected to increase spawning and rearing habitat and is intended to supplement food production and export to rearing areas.

**NEPA Effects:** Assuming BDCP habitat benefits are realized, Alternative 2A could result in an increase in the abiotic habitat index of up to 30% (compared to NAA), averaged across all water years and assuming 100% habitat occupancy (Table 11-2A-3). These effects are due to the inundation of new areas of the Delta resulting from habitat restoration effects, which will open up additional habitat for delta smelt. However, since delta smelt are pelagic, they would not be expected to occupy habitats shallower than about 3-6 feet deep in significant numbers. When analyzing effects by water years, the relative increase in abiotic habitat index would be at least 25% for all years combined, and greatest in dry years (37% NAA) and below normal years (34% NAA), with restoration. If conservation measures to restore habitat do not realize expected benefits, there would be only minor changes in abiotic habitat index.

**Table 11-2A-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 2A and Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
All	992 (25%)	106 (2%)	2,325 (58%)	1,439 (30%)
Wet	2,178 (46%)	-18 (0%)	4,065 (86%)	1,869 (27%)
Above Normal	1,729 (45%)	61 (1%)	3,243 (85%)	1,575 (29%)
Below Normal	60 (1%)	208 (5%)	1,192 (29%)	1,340 (34%)
Dry	195 (5%)	286 (8%)	1,186 (33%)	1,278 (37%)
Critical	28 (1%)	28 (1%)	743 (25%)	743 (25%)

Note: Negative values indicate lower habitat indices under preliminary proposal scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

**CEQA Conclusion:** As discussed under Alternative 1A, Alternative 2A would not result in less rearing habitat area (based on the Feyrer et al. 2011 abiotic habitat index), compared to Existing Conditions. Averaged across all water year types, Alternative 2A would result in an overall increase in the abiotic habitat index by 25% without restoration and up to 58% with restoration compared Existing Conditions (which do not include Fall X2 criteria) (Table 11-2A-3). Without BDCP habitat restoration efforts, the fall abiotic habitat index would be similar to baseline in drier years (5% more), but would increase 45–46% in above normal and wet years, when Fall X2 requirements are met. As described above, habitat restoration under Alternative 2A would further increase the delta smelt fall abiotic habitat index, resulting in up to 25–33% increase in drier years and up to 85–86% increase in wetter years, optimistically assuming 100% habitat occupancy (Figure 11-2A-3).

1 Note that the CEQA analysis predicts a greater increase in the abiotic habitat index relative to  
 2 baseline than the NEPA analysis. It is unclear whether this increase under Alternative 2A compared  
 3 to Existing Conditions is a function of Project operations, or attributable to differences in modeling  
 4 assumptions (Existing Conditions does not include Fall X2). The NEPA analysis is a better approach  
 5 for isolating the effect of the Alternative from the effects of sea level rise, climate change, future  
 6 water demands, and implementation of required actions under the BiOps such as the Fall X2  
 7 requirement. When compared to the NAA and informed by the NEPA analysis, the average delta  
 8 smelt abiotic habitat index under Alternative 2A would be similar to NAA without restoration, and  
 9 30% greater with restoration (Table 11-2A-3).

10 Overall, there would be a minor beneficial impact on the species compared to existing conditions  
 11 without Fall X2, primarily from implementation of habitat restoration. The benefits of restored  
 12 habitat for this species will depend on the success of restoration in creating physical habitat for  
 13 smelt and in fostering ecological conditions that favor good feeding conditions and production of  
 14 food upon which smelt can feed. The magnitude of restored habitat benefits is uncertain. As such,  
 15 restoration success will have to be assessed empirically during the term of the BDCP permit. BDCP  
 16 water operations will be subject to adjustment via adaptive management, in order to ensure the  
 17 impacts of water operations on rearing habitat for delta smelt are not significant and to support a  
 18 contribution to recovery of this species. The Adaptive Management Program will evaluate the effects  
 19 of water operations and habitat restoration on the delta smelt population, including adjustments as  
 20 appropriate to improve water supply reliability. In conclusion, the impact of Alternative 2A would  
 21 be less than significant and would likely provide a benefit to the species because of the increase in  
 22 available habitat. No mitigation is required.

### 23 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

24 From December to March, many mature delta smelt migrate upstream from brackish rearing areas  
 25 in and around Suisun Bay and the confluence of the Sacramento and San Joaquin Rivers (U.S. Fish  
 26 and Wildlife Service 2008a; Sommer et al. 2011). The initiation of migration is associated with  
 27 pulses of freshwater inflow, which are turbid, cool, and less saline (Grimaldo et al. 2009). Changes in  
 28 flow under Alternative2A could change turbidity, but is not expected to result in changes in water  
 29 temperatures or pulses of local rainwater into the Delta. As described above in Impact AQUA-4, in-  
 30 Delta water temperatures would not change in response to Alternative 2A flows. The modeling  
 31 results indicate no biologically meaningful changes in water temperature within the Delta under  
 32 Alternative2A and no substantial changes in the number of stressful or lethal condition days for  
 33 juveniles.

34 Turbid water is an important habitat characteristic for delta smelt (Nobriga et al. 2008; Feyrer et al.  
 35 2011), and has been correlated to long-term changes in delta smelt abundance or survival either by  
 36 itself or in combination with other factors (Thomson et al. 2010; Miller et al. 2012). Therefore, it is  
 37 assumed that turbidity is an attribute of critical importance to delta smelt larvae, juveniles, and  
 38 adults. Operation of the north Delta intakes (*CM1 Water Facilities and Operation*) is estimated to  
 39 result in around 8 to 9% less sediment entering the Plan Area from the Sacramento River, the main  
 40 source of sediment for the Delta and downstream subregions. In addition, sediment could be  
 41 accreted (captured) in the ROAs (*CM4 Tidal Natural Communities Restoration*). Notching the  
 42 Fremont Weir (*CM2 Yolo Bypass Fisheries Enhancements*) will also direct more Sacramento River  
 43 water and sediment into the Bypass. These actions could limit sediment supply to areas currently  
 44 important to delta smelt, such as Suisun Bay, which would result in less seasonal deposition of  
 45 sediment that could be resuspended by wind-wave action to make/keep the overlying water column

1 turbid. Therefore, there is a potential for a slight increase in water clarity, and a corresponding  
2 reduction in habitat quality for delta smelt. However, Alternative 2A is not expected to affect  
3 suspended sediment concentration during the first flush of precipitation that cues delta smelt  
4 migration. As such, turbidity cues associated with adult delta smelt migration should not change.  
5 With regard to suspended sediment concentrations at other times of the year, any effect will be  
6 minimized through the reintroduction of sediment collected at the north Delta intakes into tidal  
7 natural communities restoration projects (CM4), consistent with the Environmental Commitment  
8 addressing Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material.

9 **NEPA Effects:** Alternative 2 may decrease sediment supply to the estuary by 8 to 9 percent, with the  
10 potential for decreased habitat suitability for delta smelt in some locations.

11 **CEQA Conclusion:** As described above, operations under Alternative 2A would not substantially  
12 alter the turbidity cues associated with winter flush events that may initiate the adult delta smelt  
13 migration. Additionally there would be no appreciable changes in water temperatures under  
14 Alternative 2A. Consequently, the impact on adult delta smelt migration conditions would be less  
15 than significant, and no mitigation is required.

## 16 **Restoration and Conservation Measures**

17 Alternative 2A has the same restoration and conservation measures as Alternative 1A. Because no  
18 substantial differences in fish effects are anticipated anywhere in the affected environment under  
19 Alternative 2A compared to those described in detail for Alternative 1A, the effects described for  
20 delta smelt under Alternative 1A (Impact AQUA-7 through AQUA-18) also appropriately  
21 characterize effects under Alternative 2A.

22 The following impacts are those presented under Alternative 1A that are identical for Alternative  
23 2A.

### 24 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

### 25 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta** 26 **Smelt**

### 27 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

### 28 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

### 29 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

### 30 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

### 31 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

### 32 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

### 33 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

### 34 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

### 35 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

1 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
2 **(CM21)**

3 **NEPA Effects:** All of these restoration and conservation measure impact mechanisms have been  
4 determined to result in no adverse effects on delta smelt for the reasons identified for Alternative  
5 1A. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium,  
6 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt  
7 are uncertain.

8 **CEQA Conclusion:** All of these restoration and conservation measure impact mechanisms would be  
9 considered less than significant, for the reasons identified for Alternative 1A, and no mitigation  
10 would be required.

11 **Longfin Smelt**

12 **Construction and Maintenance of CM1**

13 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

14 Longfin smelt are not expected to be present in the project construction zones during the expected  
15 in-water construction window (June 1–October 31) (see Table 11-6). Therefore, there is a very low  
16 potential risk of effects from construction activities. In addition, longfin smelt are pelagic species  
17 and are less likely to be present in the construction zones than other fish species.

18 The potential effects of construction of the water conveyance facilities on longfin smelt would be  
19 similar to those described for Alternative 1A (Impact AQUA-19) except that Alternative 2A could  
20 potentially include two different intakes than under Alternative 1A. This would convert about  
21 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
22 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
23 feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
24 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
25 of contaminated sediments would be similar to Alternative 1A and the same environmental  
26 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
27 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
28 effects.

29 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-19, environmental commitments and  
30 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
31 not be adverse for longfin smelt.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-19, the impact of the construction of  
33 water conveyance facilities on longfin smelt would be less than significant except for construction  
34 noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation  
35 Measure AQUA-1b would reduce that noise impact to less than significant.

36 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
37 **of Pile Driving and Other Construction-Related Underwater Noise**

38 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

**Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise**

Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

**Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

**NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under Alternative 2A would be about the same as those described for Alternative 1A (see Impact AQUA-20). As concluded in Alternative 1A, Impact AQUA-20, the effect would not be adverse for longfin smelt.

**CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-20, the impact of the maintenance of water conveyance facilities on longfin smelt would be less than significant and no mitigation is required.

**Water Operations of CM1**

**Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

**Water Exports from SWP/CVP South Delta Facilities**

For larval longfin smelt, particle tracking model simulations indicate that overall the magnitude of entrainment risk is low under all hydrologic conditions and starting geographic distributions (wetter and drier). Average entrainment loss under Alternative 2A with the wetter starting distribution was 0.8% compared to 1.6% under NAA, a 54% relative decrease (Table 11-2A-4). Average entrainment loss with the drier starting distribution was 1.0% for Alternative 1A compared to 2.2% under NAA, a 57% decline in relative terms. The risk of entrainment would be greater during years when outflows during late winter and spring are low (generally in dry years, as modeled by drier distribution), with reduced entrainment under Alternative 2A compared to baseline conditions. Overall, larval entrainment would be reduced under Alternative 2A relative to NAA.

**Table 11-2A-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 2A and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A2A_LLT	A2A_LLT vs. EXISTING CONDITIONS	A2A_LLT vs. NAA
Wetter	1.9	1.6	0.8	-1.09 (-58%)	-0.91 (-54%)
Drier	2.5	2.2	1.0	-1.56 (-62%)	-1.29 (-57%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

Juvenile and adult longfin smelt entrainment at the south Delta facilities is calculated by normalizing salvage data against fall midwater trawl abundance indices. Entrainment under Alternative 2A would be reduced compared to NAA. Entrainment averaged across all water year types would be reduced for juvenile longfin smelt by 54% compared to NAA; entrainment would decrease for adults by 66% compared to NAA (Table 11-2A-5). As discussed for Alternative 1A (Impact AQUA-21 for

1 longfin smelt), entrainment would be highest in dry and critical years. Under Alternative 2A,  
2 entrainment in dry and critical years would be reduced 21–24% for juveniles and 25% for adults,  
3 compared to NAA. This reflects substantial reductions in reverse OMR flows under Alternative 2A  
4 for December to March.

5 **Table 11-2A-5. Longfin Smelt Entrainment Index (March–June) at the SWP and CVP Salvage**  
6 **Facilities and Differences (Absolute and Percentage) between Model Scenarios**

Life Stage	Water Year Types	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
Juvenile (March–June)	Wet	-52,640 (-83%)	-58,082 (-84%)
	Above Normal	-2,383 (-53%)	-2,673 (-55%)
	Below Normal	-637 (-21%)	-845 (-26%)
	Dry	-62,687 (-12%)	-120,994 (-21%)
	Critical	-191,393 (-34%)	-117,523 (-24%)
	All Years	-132,302 (-49%)	-157,314 (-54%)
Adult (December–March)	Wet	-98 (-76%)	-102 (-77%)
	Above Normal	-431 (-66%)	-471 (-68%)
	Below Normal	-917 (-47%)	-840 (-45%)
	Dry	-348 (-29%)	-282 (-25%)
	Critical	-7,724 (-32%)	-5,590 (-25%)
	All Years	-2,393 (-66%)	-2,357 (-66%)
Shading indicates >5% increase in entrainment index.			

7

8 ***Water Exports from SWP/CVP North Delta Intake Facilities***

9 The proposed new north Delta intakes would increase entrainment potential in this area, but  
10 entrainment of longfin smelt and potential exposure to predators at the diversion structures would  
11 be extremely low because this species is rarely encountered in surveys this far upstream (California  
12 Department of Fish and Game 2012a; 2012b; 2013b).

13 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

14 Larval entrainment to NBA was assessed by particle tracking modeling of particles, using starting  
15 distributions emulating longfin smelt distribution in wetter years (i.e., greater outflow, smelt spawn  
16 further west) and drier years (i.e., longfin smelt spawning occurs further east and deeper into the  
17 Delta). Particle entrainment at the NBA was low for both starting distributions (wetter and drier),  
18 averaging 0.13–0.16% under Alternative 2A, which was 0.05–0.06% less than NAA, or 55–64%  
19 lower in relative terms (Table 11-2A-6).

**Table 11-2A-6. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt Entrained by the North Bay Aqueduct under Alternative 2A and Baseline Scenarios**

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A2A_LLТ	A2A_LLТ vs. EXISTING CONDITIONS	A2A_LLТ vs. NAA
Wetter	0.20	0.08	0.13	-0.07 (-35.3%)	0.05 (64.0%)
Drier	0.25	0.11	0.16	-0.08 (-33.2%)	0.06 (55.1%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

Entrainment to the NBA under Alternative 2A would be increased slightly (<0.1% net change) relative to NAA.

In summary, under Alternative 2A potential entrainment of longfin smelt would be reduced at the SWP/CVP south Delta facilities and the NBA. Entrainment loss of longfin smelt at the proposed north Delta intakes would be rare because longfin smelt are not expected to occur in that area of the Sacramento River, and the intakes would be screened. NPBs would be designed to deter salmonids, but their potential ability to reduce entrainment for longfin smelt is uncertain.

**Predation Associated with Entrainment**

Pre-screen loss of longfin smelt at the south Delta facilities is typically attributed to predation (as described for Impact AQUA-3 for Alternative 1). Under Alternative 2A, pre-screen loss is expected to decrease commensurate with entrainment reductions. Predation loss at the proposed north Delta intakes and the alternate NBA intake would be limited because longfin smelt rarely occur that far upstream. **NEPA Effects:** The effect and conclusion for the risk of predation associated with the NPB structures would be the same as described for Alternative 1A. In conclusion, the effect on entrainment and entrainment-related predation loss under Alternative 2A would be beneficial because of the substantial reduction in entrainment and predation loss at the south Delta facilities.

**CEQA Conclusion:** As described above, entrainment loss of longfin smelt would be reduced under Alternative 2A. Entrainment and associated predation loss at the south Delta facilities under Alternative 2A would decrease 49% for juveniles and 66% for adults compared to Existing Conditions. Based on particle tracking simulations, entrainment of larval longfin smelt to the SWP NBA, agricultural diversions, and the south delta facilities would be expected to be less than baseline under most scenarios. Predation loss at the proposed north Delta intakes and the alternate NBA intake would be limited because longfin smelt rarely occur that far upstream.

The impact under Alternative 2A would be beneficial to the species because of the reduction in entrainment and predation loss for both juveniles and adults.

**Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt**

Adult longfin smelt inhabit primarily brackish water and marine areas in San Pablo and San Francisco Bays and nearshore coastal marine waters. Prespawning adult longfin smelt use the Delta for staging and spawning. The planktonic larvae are transported downstream after hatching; within the Plan Area, the early juvenile life stages rear in the low-salinity areas of the West Delta and

1 Suisun Bay subregions. Juvenile and adult longfin smelt occupying the Plan Area during fall through  
2 spring migrate westward into San Francisco Bay during the summer.

3 Longfin smelt spawn in the late winter and early spring months when water temperatures in the  
4 lower rivers and Delta are seasonally cool. Longfin smelt spawn adhesive eggs that are thought to be  
5 deposited on sand and gravel and possibly other hard substrates. Spawning occurs in the lower  
6 reaches of the Sacramento River in the vicinity of Cache Slough and Rio Vista, although some  
7 spawning occurs in the lower San Joaquin River based on presence of early larval and adult longfin  
8 smelt in CDFW larval trawl samples (California Department of Fish and Game 2009b). Spawning also  
9 occurs in Suisun Marsh and the Napa River.

10 Immediately after hatching from the incubating eggs, longfin smelt larvae are planktonic and drift  
11 passively with water flows; older larvae use a variety of behaviors to help retain themselves in  
12 favorable habitats (Bennett et al. 2002). Larvae are typically present in the Delta during the late  
13 winter and early spring months. Juvenile longfin smelt rear in the spring (approximately March to  
14 June) in the Suisun Bay and the West Delta subregions before migrating downstream of the Plan  
15 Area into San Pablo and San Francisco Bays and nearshore coastal marine waters, where they  
16 continue to rear for a year or more. Larval and early juvenile longfin smelt could be affected by  
17 covered activities when they are present in the Plan Area during the winter and spring months.

18 **NEPA Effects:** The indices of abundance of longfin smelt based on the Fall Midwater, Bay Otter, and  
19 Bay Midwater trawl indices have been correlated to outflow (expressed as the location of X2) in the  
20 preceding winter and spring months, when longfin smelt spawning and rearing occurs (January  
21 through June) (Kimmerer 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al.  
22 2010; Thomson et al. 2010). Modeling results based on Kimmerer et al. (2009) predict longfin smelt  
23 Fall Midwater and Bay Otter Trawl indices would decrease for most water year types, relative to  
24 NAA, based on changes in winter-spring flow alone (Table 11-2A-7). Alternative 2A operations  
25 would be expected to result in 5–6% lower longfin smelt abundance compared to NAA, for all years  
26 combined.

27 **Table 11-2A-7. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in**  
28 **the Fall Midwater Trawl or Bay Otter Trawl**

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
All	-1,665 (-32%)	-188 (-5%)	-5,336 (-37%)	-581 (-6%)
Wet	-6,317 (-35%)	48 (0.4%)	-25,962 (-40%)	186 (0.5%)
Above Normal	-3,557 (-41%)	-725 (-13%)	-12,475 (-47%)	-2,430 (-15%)
Below Normal	-1,508 (-35%)	-209 (-7%)	-4,639 (-41%)	-619 (-8%)
Dry	-616 (-29%)	-123 (-8%)	-1,658 (-34%)	-321 (-9%)
Critical	-158 (-17%)	-24 (-3%)	-369 (-20%)	-55 (-3%)

Shading indicates greater than 10% decrease in relative abundance.

29  
30 During the period of longfin smelt rearing from January–June, Delta outflows would be similar  
31 (<10% difference) to NAA in all months except April, when flows would be reduced 11%.

1 Longfin smelt may also benefit from habitat restoration actions (*CM2 Yolo Bypass Fisheries*  
2 *Enhancement and CM4 Tidal Natural Communities Restoration*, which are intended to provide  
3 additional food production and export to longfin smelt rearing areas in Suisun Marsh, West Delta,  
4 and Cache Slough ROAs.

5 **CEQA Conclusion:** Average Delta outflow under Alternative 2 would be similar (less than 5%  
6 difference) to Existing Conditions in winter (January, February, March) and decreased in spring  
7 (13% in April, 22% in May, 17% in June). Relative longfin smelt abundance based on Kimmerer et al.  
8 2009 decreased 32–37% on average compared to Existing Conditions (Table 11-2A-6), with greatest  
9 reductions in above normal water years (41–47% lower under Alternative 2A). Average juvenile  
10 longfin smelt relative abundance, based on Kimmerer et al. 2009, decreased 31–36% compared to  
11 Existing Conditions (Table 11-2A-6).

12 Contrary to the NEPA conclusion set forth above, these results indicate that the difference between  
13 Existing Conditions and Alternative 2 could be significant because the alternative could substantially  
14 reduce relative abundance based on Kimmerer et al. 2009. However, as discussed earlier  
15 (Alternative 1A, Impact AQUA-22), this interpretation of the biological modeling results is likely  
16 attributable to different modeling assumptions for four factors: sea level rise, climate change, future  
17 water demands, and implementation of the alternative. As discussed above (Section 11.3.3), because  
18 of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA  
19 significance conclusions to vary between one another under the same impact discussion. The  
20 baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the  
21 action alternative and the NEPA baseline (NAA) models anticipated future conditions that would  
22 occur in 2060 (LLT implementation period), including the projected effects of climate change  
23 (precipitation patterns), sea level rise and future water demands, as well as implementation of  
24 required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action  
25 alternative modeling does not partition the effects of implementation of the alternative from the  
26 effects of sea level rise, climate change and future water demands, the comparison to Existing  
27 Conditions may not offer a clear understanding of the impact of the alternative on the environment.  
28 This suggests that the NEPA analysis, which compares results between the alternative and NAA, is a  
29 better approach because it isolates the effect of the alternative from those of sea level rise, climate  
30 change, and future water demands.

31 When compared to NAA and informed by the NEPA analysis above, longfin smelt relative abundance,  
32 based on Kimmerer et al. (2009), decreased 5% to 6% on average relative to conditions without  
33 BDCP (Table 11-2A-6). These results represent the increment of change attributable to the  
34 alternative and address the limitations of the comparison the CEQA baseline (Existing Conditions).  
35 Therefore, operations under Alternative 2A would not in itself result in a significant impact on  
36 longfin smelt rearing.

37 This impact is found to be less than significant, and no mitigation is required. Furthermore, as  
38 described above, other measures such as habitat restoration (CM4) could improve the quality of  
39 spawning and rearing habitat for longfin smelt, although there is some uncertainty of the outcome  
40 related to habitat restoration.

#### 41 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

42 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on rearing habitat  
43 for longfin smelt is included in *Impact AQUA-22: Effects of Water Operations on Spawning, Egg*  
44 *Incubation, and Rearing Habitat for Longfin Smelt*.

1 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

2 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on migration  
3 conditions for longfin smelt is included in *Impact AQUA-22: Effects of Water Operations on Spawning,*  
4 *Egg Incubation, and Rearing Habitat for Longfin Smelt.*

5 **Restoration and Conservation Measures**

6 Alternative 2A has the same restoration and conservation measures as Alternative 1A. Because no  
7 substantial differences in fish effects are anticipated anywhere in the affected environment under  
8 Alternative 2A compared to those described in detail for Alternative 1A, the effects described for  
9 longfin smelt under Alternative 1A (Impact AQUA-25 through AQUA-36) also appropriately  
10 characterize effects under Alternative 2A.

11 The following impacts are those presented under Alternative 1A that are identical for Alternative  
12 2A.

13 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

14 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**  
15 **Smelt**

16 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

17 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

18 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
19 **(CM13)**

20 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

21 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

22 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

23 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

24 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

25 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

26 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
27 **(CM21)**

28 **NEPA Effects:** These restoration and conservation measure impact mechanisms have been  
29 determined to range from no effect, to not adverse, or beneficial effects on longfin smelt for NEPA  
30 purposes, for the reasons identified for Alternative 1A. Specifically for AQUA-26, the effects of  
31 contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not  
32 be adverse. The effects of methylmercury on longfin smelt are uncertain.

1 **CEQA Conclusion:** These restoration and conservation measure impact mechanisms would be  
2 considered to range from no impact, be less than significant, or beneficial on longfin smelt, for the  
3 reasons identified for Alternative 1A, and no mitigation is required.

#### 4 **Winter-Run Chinook Salmon**

##### 5 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 6 **(Winter-Run ESU)**

7 The potential effects of construction of the water conveyance facilities on Chinook salmon would be  
8 similar to those described for Alternative 1A (Impact AQUA-37) except that Alternative 2A could  
9 potentially include two different intakes than under Alternative 1A. This would convert about  
10 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
11 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
12 feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
13 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
14 of contaminated sediments would be similar to Alternative 1A and the same environmental  
15 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
16 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
17 effects.

18 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-37, environmental commitments and  
19 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
20 not be adverse for Chinook salmon.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-37 for Chinook salmon, the impact  
22 of the construction of water conveyance facilities on Chinook salmon would be less than significant  
23 except for construction noise associated with pile driving. Implementation of Mitigation Measure  
24 AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

##### 25 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 26 **of Pile Driving and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

##### 28 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 29 **and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

##### 31 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 32 **(Winter-Run ESU)**

33 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
34 Alternative 2A would be about the same as those described for Alternative 1A (see Impact AQUA-  
35 38). As concluded in Alternative 1A, Impact AQUA-38, the impact would not be adverse for Chinook  
36 salmon.

37 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38 for Chinook salmon, the impact  
38 of the maintenance of water conveyance facilities on Chinook salmon would be less than significant  
39 and no mitigation is required.

1 **Water Operations of CM1**

2 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**  
3 **Run ESU)**

4 ***Water Exports from SWP/CVP South Delta Facilities***

5 Entrainment losses would be reduced under Alternative 2A (A2A\_LLT) at the south Delta facilities.  
6 Losses for all years combined would decrease by approximately 5,000 fish (67–68%) compared to  
7 NAA (Table 11-2A-8). Entrainment would be reduced in all water year types, ranging from moderate  
8 reductions in critical water years (18% fewer fish compared to NAA) to significant reductions in wet  
9 years (90% fewer fish entrained) (Table 11-2A-8). Pre-screen losses, typically attributed to  
10 predation, would be expected to decrease commensurate with decreased entrainment at the south  
11 Delta facilities.

12 The proportion of the annual winter-run Chinook population (assumed to be 500,000 juveniles  
13 approaching the Delta) lost at the south Delta facilities across all years is very small, averaging 1.4%  
14 under NAA and decreasing to 0.4% under Alternative 2A

15 **Table 11-2A-8. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index at the SWP and**  
16 **CVP Salvage Facilities—Differences between Model Scenarios for Alternative 2A**

Water Year Type	Absolute Difference (Percent Difference) <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-10,144 (-89%)	-10,565 (-90%)
Above Normal	-5,399 (-81%)	-5,523 (-82%)
Below Normal	-3,751 (-52%)	-3,327 (-49%)
Dry	-1,175 (-31%)	-868 (-25%)
Critical	-347 (-27%)	-208 (-18%)
All Years	-4,598 (-68%)	-4,539 (-67%)

Shading indicates 10% or greater increased entrainment.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data.

17

18 ***Water Exports from SWP/CVP North Delta Intake Facilities***

19 The effect of Alternative 2A on entrainment and impingement at the North Delta facilities would be  
20 the same as described for Alternative 1A (Impact AQUA-39) because both alternatives would have  
21 state-of-the-art screens installed to prevent entrainment and be designed to minimize impingement.

22 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

23 The effect would be the same as described for Alternative 1A (Impact AQUA-39). Entrainment and  
24 impingement effects would be minimal for Alternative 2A because intakes would have state-of-the-  
25 art screens installed.

26 ***Predation Associated with Entrainment***

27 Pre-screen loss of juvenile Chinook salmon at the south Delta facilities is typically attributed to  
28 predation, and is expected to decrease under Alternative 2A, commensurate with entrainment

1 reductions. Predation loss at the proposed north Delta intakes and the alternate NBA intake would  
2 be limited because of the state-of-the-art, positive barrier screens installed.

3 **NEPA Effects:** Due to reduced entrainment at the south Delta facilities, the effect of Alternative 2A  
4 water operations on winter-run Chinook entrainment would be beneficial.

5 **CEQA Conclusion:** As described above, entrainment losses of juvenile Chinook salmon at the south  
6 Delta facilities would decrease under Alternative 2A (A2A\_LLT) compared to Existing Conditions  
7 (Table 11-2A-8). At the north Delta facilities and the alternate NBA intake, the screened intakes as  
8 designed would exclude this species, although there is some potential for impingement or contact by  
9 smaller fish with the screen. Overall impacts of Alternative 2A water operations on entrainment of  
10 Chinook salmon (winter-run ESU) would be beneficial due to a reduction in entrainment and no  
11 mitigation would be required.

12 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
13 **Chinook Salmon (Winter-Run ESU)**

14 In general, Alternative 2A would reduce the quantity and quality of spawning and egg incubation  
15 habitat for winter-run Chinook salmon relative to NAA

16 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were  
17 examined during the May through September winter-run spawning period (Appendix 11C, CALSIM  
18 II Model Results utilized in the Fish Analysis). Lower flows can reduce the instream area available  
19 for spawning and egg incubation. Flows under A2A\_LLT during May and June would generally be  
20 similar to or greater than flows under NAA. Flows under A2A\_LLT during July, August, and  
21 September would generally be lower than flows under NAA by up to 20%. These results indicate  
22 that there would be intermittent negligible-to-small flow-related effects of Alternative 2A on  
23 spawning and egg incubation habitat.

24 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the  
25 May through September winter-run spawning and egg incubation period. May Shasta storage  
26 volume under A2A\_LLT would be similar to or greater than storage under NAA for all water year  
27 types (Table 11-2A-9).

28 **Table 11-2A-9. Difference and Percent Difference in May Water Storage Volume (thousand acre-**  
29 **feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-19 (0%)	15 (0%)
Above Normal	-89 (-2%)	-3 (0%)
Below Normal	-102 (-2%)	96 (2%)
Dry	-230 (-6%)	214 (6%)
Critical	-218 (-9%)	366 (20%)

30  
31 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
32 examined during the May through September winter-run spawning period (Appendix 11D,  
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
34 *Fish Analysis*). There would be no substantial differences (<5%) in mean monthly water temperature

1 between NAA and Alternative 2A in any month or water year type throughout the period at either  
2 location.

3 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
4 determined for each month (May through September) and year of the 82-year modeling period  
5 (Table 11-2A-10). The combination of number of days and degrees above the 56°F threshold were  
6 further assigned a “level of concern” as defined in Table 11-2A-11. Differences between baselines  
7 and Alternative 2A in the highest level of concern across all months and all 82 modeled years are  
8 presented in Table 11-2A-12. There would be no difference in levels of concern between NAA and  
9 Alternative 2A.

10 **Table 11-2A-10. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided**  
11 **by NMFS and Used in the BDCP Effects Analysis**

Location	Period	Maximum Water Temperature (°F)	Purpose
<b>Upper Sacramento River</b>			
Bend Bridge	May–Sep	56	Winter- and spring-run spawning and egg incubation
		63	Green sturgeon spawning and egg incubation
Red Bluff	Oct–Apr	56	Spring-, fall-, and late fall–run spawning and egg incubation
Hamilton City	Mar–Jun	61 (optimal), 68 (lethal)	White sturgeon spawning and egg incubation
<b>Feather River</b>			
Robinson Riffle (RM 61.6)	Sep–Apr	56	Spring-run and steelhead spawning and incubation
	May–Aug	63	Spring-run and steelhead rearing
Gridley Bridge	Oct–Apr	56	Fall- and late fall–run spawning and steelhead rearing
	May–Sep	64	Green sturgeon spawning, incubation, and rearing
<b>American River</b>			
Watt Avenue Bridge	May–Oct	65	Juvenile steelhead rearing

12

13 **Table 11-2A-11. Number of Days per Month Required to Trigger Each Level of Concern for Water**  
14 **Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided**  
15 **by NMFS and Used in the BDCP Effects Analysis**

Exceedance above Water Temperature Threshold (°F)	Level of Concern			
	None	Yellow	Orange	Red
1	0-9 days	10-14 days	15-19 days	≥20 days
2	0-4 days	5-9 days	10-14 days	≥15 days
3	0 days	1-4 days	5-9 days	≥10 days

16

1 **Table 11-2A-12. Differences between Baseline and Alternative 2A Scenarios in the Number of**  
 2 **Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**  
 3 **Sacramento River at Bend Bridge, May through September**

Level of Concern <sup>a</sup>	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
Red	33 (67%)	0 (0%)
Orange	-14 (-100%)	0 (NA)
Yellow	-16 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> For definitions of levels of concern, see Table 11-2A-11.

4  
 5 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
 6 during May through September (Table 11-2A-13). Total degree-days under Alternative 2A would be  
 7 up to 12% lower than under NAA during May and June and up to 16% higher during July through  
 8 September.

1 **Table 11-2A-13. Differences between Baseline and Alternative 2A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**  
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
May	Wet	987 (262%)	-215 (-14%)
	Above Normal	213 (100%)	-142 (-25%)
	Below Normal	431 (197%)	-32 (-5%)
	Dry	235 (126%)	-179 (-30%)
	Critical	477 (216%)	67 (11%)
	All	2,344 (193%)	-500 (-12%)
June	Wet	391 (102%)	-320 (-29%)
	Above Normal	48 (32%)	-181 (-48%)
	Below Normal	304 (219%)	-48 (-10%)
	Dry	554 (295%)	20 (3%)
	Critical	628 (157%)	78 (8%)
	All	1,926 (153%)	-450 (-12%)
July	Wet	757 (146%)	151 (13%)
	Above Normal	374 (462%)	104 (30%)
	Below Normal	670 (456%)	214 (35%)
	Dry	1,295 (459%)	367 (30%)
	Critical	1,873 (227%)	87 (3.3%)
	All	4,968 (268%)	922 (16%)
August	Wet	2,187 (314%)	224 (8%)
	Above Normal	901 (221%)	242 (23%)
	Below Normal	1,279 (483%)	244 (19%)
	Dry	2,098 (313%)	488 (21%)
	Critical	2,764 (186%)	145 (4%)
	All	9,229 (262%)	1,342 (12%)
September	Wet	833 (113%)	124 (9%)
	Above Normal	559 (78%)	159 (14%)
	Below Normal	1,572 (211%)	426 (23%)
	Dry	2,585 (202%)	-11 (0%)
	Critical	1,971 (95%)	80 (2%)
	All	7,523 (135%)	778 (6%)

NA = could not be calculated because the denominator was 0.

4

5 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
 6 Sacramento River under A2A\_LLT would be lower or similar to mortality under NAA except in below  
 7 normal and dry water years (82% and 20%, respectively). The increase in the percent of winter-run  
 8 population subject to mortality would be 1% in both below normal and dry years. Therefore, the  
 9 increase in mortality of 1% from NAA to A2A\_LLT, although relatively large, would be negligible at  
 10 an absolute scale to the winter-run population (Table 11-2A-14). These results indicate that climate  
 11 change would cause the majority of the increase in winter-run egg mortality.

**Table 11-2A-14. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	1 (252%)	-0.1 (-7%)
Above Normal	2 (339%)	-0.1 (-3%)
Below Normal	2 (239%)	1 (82%)
Dry	7 (477%)	1 (20%)
Critical	42 (157%)	-2 (-3%)
All	9 (189%)	0.3 (2%)

SacEFT predicts that there would be a 31% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A2A\_LLT relative to NAA (Table 11-2A-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A2A\_LLT would be similar to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A2A\_LLT would be similar to that under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A2A\_LLT would be similar to NAA. These results indicate that there would be a small negative effect of Alternative 2A on spawning habitat.

The biological significance of a reduction in available suitable spawning habitat varies at the population level in response to a number of factors, including adult escapement. For those years when adult escapement is less than the carrying capacity of the spawning habitat, a reduction in area would have little or no population level effect. In years when escapement exceeds carrying capacity of the reduced habitat, competition among spawners for space (e.g., increased redd superimposition) would increase, resulting in reduced reproductive success. The reduction in the frequency of years in which spawning habitat availability is considered to be good by SacEFT could result in reduced reproductive success and abundance of winter-run Chinook salmon if the number of spawners is limited by spawning habitat quantity.

**Table 11-2A-15. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Spawning WUA	-36 (-62%)	-10 (-31%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-26 (-27%)	-3 (-4%)
Redd Dewatering Risk	4 (16%)	0 (0%)
Juvenile Rearing WUA	-24 (-48%)	1 (4%)
Juvenile Stranding Risk	-3 (-15%)	-14 (-45%)

WUA = Weighted Usable Area.

**NEPA Effects:** Considering the range of results presented here for winter-run Chinook salmon spawning and egg incubation, this effect would be adverse because it has the potential to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. There would be small to moderate reductions in flow during a substantial

1 portion (3 of 5 months) of the spawning and egg incubation period that would reduce spawning and  
 2 egg incubation conditions for winter-run Chinook salmon. Further, SacEFT predicts that the extent  
 3 of winter-run spawning habitat would be reduced by 31% under Alternative 2A (Table 11-2A-15).  
 4 This effect is a result of the specific reservoir operations and resulting flows associated with this  
 5 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
 6 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
 7 the alternative, thereby making it a different alternative than that which has been modeled and  
 8 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
 9 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-40a through AQUA-  
 10 40c) has the potential to reduce the severity of impact, although not necessarily to a not adverse  
 11 level.

12 **CEQA Conclusion:** In general, Alternative 2A would reduce the quantity and quality of spawning and  
 13 egg incubation habitat for winter-run Chinook salmon relative to the Existing Conditions.

14 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined  
 15 during the May through September winter-run spawning and egg incubation period (Appendix 11C,  
 16 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be  
 17 similar to or greater than flows under Existing Conditions during May and June and generally lower  
 18 by up to 27% during July, August, and September.

19 Shasta Reservoir storage volume at the end of May under A2A\_LLT would be similar to Existing  
 20 Conditions in wet, above normal, and below normal water years, but lower by 6% to 9% in dry and  
 21 critical water years, respectively (Table 11-2A-9). This indicates that there would be a small to  
 22 moderate effect of Alternative 2A on flows during the spawning and egg incubation period.

23 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
 24 examined during the May through September winter-run spawning period (Appendix 11D,  
 25 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 26 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 27 Existing Conditions and Alternative 2A during May and June. Mean monthly water temperature  
 28 would be up to 12% higher under Alternative 2A in July through September depending on month,  
 29 water year type, and location.

30 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
 31 determined for each month (May through September) and year of the 82-year modeling period  
 32 (Table 11-2A-10). The combination of number of days and degrees above the 56°F threshold were  
 33 further assigned a “level of concern” as defined in Table 11-2A-11. The number of years classified as  
 34 “red” would increase by 67% under Alternative 2A relative to Existing Conditions (Table 11-2A-12).

35 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
 36 during May through September (Table 11-2A-13). Total degree-days under Alternative 2A would be  
 37 135% to 313% higher than that under Existing Conditions depending on month throughout the  
 38 period.

39 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
 40 Sacramento River under A2A\_LLT would be 157–477% greater than mortality under Existing  
 41 Conditions depending on water year type (Table 11-2A-14). These increases would only affect the  
 42 winter-run population during dry and critical years, in which the absolute percent increase of the

1 winter-run population would be 7 and 42%, respectively. These results indicate that Alternative 2A  
2 would cause increased winter-run Chinook salmon egg mortality in the Sacramento River.

3 SacEFT predicts that there would be a 62% decrease in the percentage of years with good spawning  
4 availability, measured as weighted usable area, under A2A\_LLT relative to Existing Conditions  
5 (Table 11-2A-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk  
6 under A2A\_LLT would be similar to the percentage of years under Existing Conditions. SacEFT  
7 predicts that the percentage of years with good egg incubation conditions under A2A\_LLT would be  
8 27% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good  
9 (lower) redd dewatering risk under A2A\_LLT would be 16% greater than the percentage of years  
10 under Existing Conditions. These results indicate that Alternative 2A would cause small to moderate  
11 reductions in spawning WUA and egg incubation conditions.

12 Collectively, these results indicate that the impact would be significant because it has the potential  
13 to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a  
14 result of egg mortality. Exceedances of NMFS temperature thresholds would be substantially greater  
15 under Alternative 2A. Egg mortality in drier years, during which winter-run Chinook salmon would  
16 already be stressed due to reduced flows and increased temperatures, would be up to 42% greater  
17 due to Alternative 2A compared to the Existing Conditions (Table 11-2A-14). Further, the extent of  
18 spawning habitat would be 62% lower due to Alternative 2A compared to the Existing Conditions  
19 (Table 11-2A-15), which represents a substantial reduction in spawning habitat and, therefore, in  
20 adult spawner and redd carrying capacity. This impact is a result of the specific reservoir operations  
21 and resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
22 operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-  
23 significant level would fundamentally change the alternative, thereby making it a different  
24 alternative than that which has been modeled and analyzed. As a result, this impact is significant and  
25 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation  
26 that has the potential to reduce the severity of impact though not necessarily to a less-than-  
27 significant level.

28 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional**  
29 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
30 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

31 Although analysis conducted as part of the EIR/EIS determined that Alternative 2A would have  
32 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
33 the best available scientific information at the time and may prove to have been overstated.  
34 Upon the commencement of operations of CM1 and continuing through the life of the permit, the  
35 BDCP proponents will monitor effects on spawning habitat in order to determine whether such  
36 effects would be as extensive as concluded at the time of preparation of this document and to  
37 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
38 measure requires a series of actions to accomplish these purposes, consistent with the  
39 operational framework for Alternative 2A.

40 The development and implementation of any mitigation actions shall be focused on those  
41 incremental effects attributable to implementation of Alternative 2A operations only.  
42 Development of mitigation actions for the incremental impact on spawning habitat attributable  
43 to climate change/sea level rise are not required because these changed conditions would occur  
44 with or without implementation of Alternative 2A.

1           **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts**  
2           **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

3           Following commencement of initial operations of CM1 and continuing through the life of the  
4           permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
5           modified operations could reduce impacts to spawning habitat under Alternative 2A. The  
6           analysis required under this measure may be conducted as a part of the Adaptive Management  
7           and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

8           **Mitigation Measure AQUA-40c: Consult with NMFS, USFWS, and CDFW to Identify and**  
9           **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
10          **Salmon Spawning Habitat Consistent with CM1**

11          In order to determine the feasibility of reducing the effects of CM1 operations on winter-run  
12          Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and CDFW to  
13          identify and implement any feasible operational means to minimize effects on spawning habitat.  
14          Any such action will be developed in conjunction with the ongoing monitoring and evaluation of  
15          habitat conditions required by Mitigation Measure AQUA-40a.

16          If feasible means are identified to reduce impacts on spawning habitat consistent with the  
17          overall operational framework of Alternative 2A without causing new significant adverse  
18          impacts on other covered species, such means shall be implemented. If sufficient operational  
19          flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under  
20          Alternative 2A operations, achieving further impact reduction pursuant to this mitigation  
21          measure would not be feasible under this Alternative, and the impact on winter-run Chinook  
22          salmon would remain significant and unavoidable.

23          **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
24          **(Winter-Run ESU)**

25          In general, Alternative 2A would reduce the quantity and quality of rearing habitat for fry and  
26          juvenile winter-run Chinook salmon relative to NAA.

27          Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
28          salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
29          *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing  
30          habitat. Flows under A2A\_LLT would generally be lower than flows under NAA by up to 17% during  
31          August and November, and similar to or greater than flows under NAA during September, October,  
32          and December.

33          Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
34          examined during the August through December winter-run juvenile rearing period (Appendix 11D,  
35          *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
36          *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
37          NAA and Alternative 2A in any month or water year type throughout the period at either location.

38          SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
39          measured as weighted usable area, under A2A\_LLT would not be different from the percentage of  
40          years under NAA (Table 11-2A-14). In addition, the percentage of years with good (low) juvenile  
41          stranding risk under A2A\_LLT is predicted to be 45% (14% on an absolute scale) lower than under

1 NAA. This indicates that the quantity and quality of juvenile rearing habitat in the Sacramento River  
2 would be lower under A2A\_LLT relative to NAA.

3 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A2A\_LLT would  
4 have a negligible difference (<5%) in habitat-related mortality with NAA.

5 **NEPA Effects:** Collectively, these results indicate that the effect is adverse because it has the  
6 potential to substantially reduce the amount of suitable habitat and substantially interfere with the  
7 movement of fish. There would be no substantial effects of Alternative 2A on flows or water  
8 temperatures. However, effects on juvenile stranding risk are substantial (45% increase) relative to  
9 NAA. This effect is a result of the specific reservoir operations and resulting flows associated with  
10 this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows)  
11 to the extent necessary to reduce this effect to a level that is not adverse would fundamentally  
12 change the alternative, thereby making it a different alternative than that which has been modeled  
13 and analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
14 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-41a through AQUA-  
15 41c) has the potential to reduce the severity of impact though not necessarily to not adverse level.

16 **CEQA Conclusion:** In general, Alternative 2A would reduce the quantity and quality of fry and  
17 juvenile rearing habitat for winter-run Chinook salmon relative to the Existing Conditions.

18 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
19 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
20 *in the Fish Analysis*). Flows under A2A\_LLT would generally be similar to or greater than flows under  
21 Existing Conditions during October and December, but up to 24% lower than Existing Conditions  
22 during August, September, and November.

23 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
24 examined during the August through December winter-run rearing period (Appendix 11D,  
25 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
26 *Fish Analysis*). Mean monthly water temperature would be up to 14% higher under Alternative 2A in  
27 July through October depending on month, water year type, and location. There would be no  
28 differences (<5%) between Existing Conditions and Alternative 2A in mean monthly water  
29 temperature during November and December at either location.

30 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
31 measured as weighted usable area, under A2A\_LLT would be 48% lower than under Existing  
32 Conditions (Table 11-2A-15). In addition, the percentage of years with good (low) juvenile stranding  
33 risk under A2A\_LLT is predicted to be 15% lower than under Existing Conditions. This indicates that  
34 the quantity and quality of juvenile rearing habitat in the Sacramento River would be lower under  
35 A2A\_LLT relative to Existing Conditions.

36 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A2A\_LLT would  
37 be 15% higher than under Existing Conditions.

38 These results indicate that the impact would be significant because it has the potential to  
39 substantially reduce the amount of suitable habitat and substantially interfere with the movement of  
40 fish. Differences in flows are moderately large during the majority of months and water years types.  
41 Further, a 48% reduction in rearing habitat quantity and 15% increase in stranding risk would  
42 reduce upstream habitat conditions for winter-run fry and juveniles. Water temperatures would be  
43 higher than those under NAA in the Sacramento River during a substantial portion of the winter-run

1 rearing period. This impact is a result of the specific reservoir operations and resulting flows  
2 associated with this alternative. Applying mitigation (e.g., changing reservoir operations in order to  
3 alter the flows) to the extent necessary to reduce this impact to a less-than-significant level would  
4 fundamentally change the alternative, thereby making it a different alternative than that which has  
5 been modeled and analyzed. As a result, this impact is significant and unavoidable because there is  
6 no feasible mitigation available. Even so, proposed below is mitigation that has the potential to  
7 reduce the severity of impact though not necessarily to a less-than-significant level.

8 **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**  
9 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
10 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

11 Although analysis conducted as part of the EIR/EIS determined that Alternative 2A would have  
12 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
13 best available scientific information at the time and may prove to have been overstated. Upon  
14 the commencement of operations of CM1 and continuing through the life of the permit, the  
15 BDCP proponents will monitor effects on rearing habitat in order to determine whether such  
16 effects would be as extensive as concluded at the time of preparation of this document and to  
17 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
18 measure requires a series of actions to accomplish these purposes, consistent with the  
19 operational framework for Alternative 2A.

20 The development and implementation of any mitigation actions shall be focused on those  
21 incremental effects attributable to implementation of Alternative 2A operations only.  
22 Development of mitigation actions for the incremental impact on rearing habitat attributable to  
23 climate change/sea level rise are not required because these changed conditions would occur  
24 with or without implementation of Alternative 2A.

25 **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**  
26 **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

27 Following commencement of initial operations of CM1 and continuing through the life of the  
28 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
29 modified operations could reduce impacts to rearing habitat under Alternative 2A. The analysis  
30 required under this measure may be conducted as a part of the Adaptive Management and  
31 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

32 **Mitigation Measure AQUA-41c: Consult with NMFS, USFWS, and CDFW to Identify and**  
33 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
34 **Salmon Rearing Habitat Consistent with CM1**

35 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run  
36 Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and CDFW to  
37 identify and implement any feasible operational means to minimize effects on rearing habitat.  
38 Any such action will be developed in conjunction with the ongoing monitoring and evaluation of  
39 habitat conditions required by Mitigation Measure AQUA-41a.

40 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
41 operational framework of Alternative 2A without causing new significant adverse impacts on  
42 other covered species, such means shall be implemented. If sufficient operational flexibility to

1 reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 2A  
2 operations, achieving further impact reduction pursuant to this mitigation measure would not  
3 be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain  
4 significant and unavoidable.

### 5 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon** 6 **(Winter-Run ESU)**

7 In general, Alternative 2A would affect migration conditions for winter-run Chinook salmon relative  
8 to NAA.

#### 9 **Upstream of the Delta**

10 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November  
11 juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run  
12 Chinook salmon to migrate effectively down the Sacramento River. Flows under A2A\_LLT would  
13 generally be similar to flows under NAA, except during August and November, in which flows would  
14 be up to 17% lower under A2A\_LLT. These flow reductions would not be of a high enough  
15 magnitude to have biologically meaningful effects on juvenile emigration conditions.

16 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
17 examined during the July through November winter-run Chinook salmon juvenile emigration period  
18 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
19 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
20 temperature between NAA and Alternative 2A in any month or water year type throughout the  
21 period at either location.

22 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run  
23 Chinook salmon upstream migration period (December through August). A reduction in flows may  
24 reduce the olfactory cues needed by adults to return to natal spawning grounds in the upper  
25 Sacramento River. Flows under A2A\_LLT would generally be similar to or greater than those under  
26 NAA except for wet water years during August, in which flows would be up to 14% lower under  
27 A2A\_LLT. These reductions would not be large or frequent enough to cause biologically meaningful  
28 effects on adult migration conditions.

29 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
30 examined during the December through August winter-run Chinook salmon upstream migration  
31 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
32 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
33 temperature between NAA and Alternative 2A in any month or water year type throughout the  
34 period at either location.

35 Migration flows and water temperatures would not differ substantially between Alternative 2A and  
36 NAA.

#### 37 **Through-Delta**

38 The effects of Alternative 2A on through-Delta migration were evaluated using the approach  
39 described in Alternative 1A, Impact AQUA-42.

1 **Juveniles**

2 During the juvenile winter-run Chinook salmon emigration period (November to early May), mean  
3 monthly flows downstream of the north Delta diversion facility under Alternative 2A would be  
4 reduced up to 25% depending on the month compared to NAA.

5 The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish  
6 around the intake structures. The predation effects of Alternative 2A would be the same as those  
7 described for Alternative 1A (see details in Impact AQUA-42), since there are five intakes for both  
8 alternatives. The five NDD intakes would remove or modify habitat along that portion of the  
9 migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation  
10 losses at the north Delta intakes, as estimated by the bioenergetics model with median density of  
11 predators (119 striped bass per 1,000 feet of intake), would be less than 2% compared to the annual  
12 production estimated for the Sacramento Valley (Table 11-1A-17). A conservative assumption of 5%  
13 loss per intake would yield a cumulative loss of 18.5% of juvenile winter-run Chinook that reach the  
14 north Delta. This assumption is uncertain and represents an upper bound estimate.

15 Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was  
16 modeled by the DPM. Average survival under Alternative 2A would be 33% across all years, 26% in  
17 drier years, and 45% in wetter years (Table 11-2A-16). Compared to NAA, juvenile survival would  
18 decrease 1.2% across all year (a 4% relative decrease) and decrease 1.5% (5% relative decrease) in  
19 drier years.

20 **Table 11-2A-16. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**  
21 **under Alternative 2A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A2A_LLТ	EXISTING CONDITIONS vs. A2A_LLТ	NAA vs. A2A_LLТ
Wetter Years	46.3	46.1	45.2	-1.1 (-3%)	-0.9 (-2%)
Drier Years	28.0	27.1	25.7	-2.3 (-8%)	-1.5 (-5%)
All Years	34.9	34.2	33.0	-1.9 (-5%)	-1.2 (-4%)

Note: Delta Passage Model results for survival to Chipps Island.  
Wetter = Wet and above normal water years (6 years).  
Drier = Below normal, dry and critical water years (10 years).

22

23 **Adults**

24 Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, declined  
25 under Alternative 2A by no more than 10% during the December through June migration period for  
26 winter-run adults (Table 11-2A-17). The reductions in percentage are small in comparison with the  
27 magnitude of change in dilution reported to cause a significant change in migration by Fretwell  
28 (1989) and, therefore, are not expected to affect winter-run migration. However, uncertainty  
29 remains with regard to adult salmon behavioral response to anticipated changes in lower  
30 Sacramento River flow percentages. For further discussion of the topic see the analysis for  
31 Alternative 1A.

1 **Table 11-2A-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River**  
 2 **and San Joaquin River during the Adult Chinook Migration Period for Alternative 2A**

Month	Percentage of Water			Difference	
	EXISTING CONDITIONS	NAA	A2A_LL	EXISTING CONDITIONS vs. A2A_LL	NAA vs. A2A_LL
<b>Sacramento River</b>					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	59	-10	-6
<b>San Joaquin River</b>					
September	0.3	0.1	1.3	1.0	1.2
October	0.2	0.3	3.6	3.4	3.3
November	0.4	1.0	5.4	5.0	4.4
December	0.9	1.0	3.0	2.1	2.0
January	1.6	1.7	3.2	1.6	1.5
February	1.4	1.5	3.8	2.4	2.3
March	2.6	2.8	6.1	3.5	3.3
April	6.3	6.6	10.6	4.3	4.0
Shading indicates a difference of 10% or greater in flow proportion.					

3  
 4 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 2A is adverse due to the  
 5 cumulative effects associated with five north Delta intake facilities, including mortality related to  
 6 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to  
 7 reduced flows downstream of the intakes) associated with the five NDD intakes.

8 Upstream of the Delta, Alternative 2A would not affect migration conditions for winter-run Chinook  
 9 salmon, as migration flows and water temperatures would not differ substantially between  
 10 Alternative 2A and NAA.

11 Adult attraction flows under Alternative 2A would be lower than those under NAA, but adult  
 12 attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

13 Near-field effects of Alternative 2A NDD on winter-run Chinook salmon related to impingement and  
 14 predation associated with five new intakes could result in substantial effects on juvenile migrating  
 15 winter-run Chinook salmon, although there is high uncertainty regarding the potential effects.  
 16 Estimates within the effects analysis range from very low levels of effects (<1% mortality) to very  
 17 significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented  
 18 with the intent of providing localized and temporary reductions in predation pressure at the NDD.  
 19 Additionally, several pre-construction surveys to better understand how to minimize losses  
 20 associated with the five new intake structures will be implemented as part of the final NDD screen

1 design effort. Alternative 2A also includes an Adaptive Management Program and Real-Time  
2 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
3 adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of  
4 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality  
5 expected from near-field effects at the NDD remains highly uncertain.

6 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
7 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
8 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 2A  
9 predict improvements in smolt condition and survival associated with increased access to the Yolo  
10 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
11 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
12 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

13 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
14 all of these elements of BDCP operations and conservation measures to predict smolt migration  
15 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
16 migration survival under Alternative 2A would be similar to survival rates estimated for NAA.  
17 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
18 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
19 future. These efforts are expected to improve our understanding of the relationships and  
20 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
21 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
22 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
23 2A on winter-run Chinook salmon through-Delta survival remains uncertain.

24 Therefore, primarily as a result of reduced upstream migration habitat conditions for winter-run  
25 Chinook salmon due to reduced flows along with unacceptable levels of uncertainty regarding the  
26 cumulative impacts of near-field and far-field effects associated with the presence and operation of  
27 the five intakes on winter-run Chinook salmon, this effect is adverse. While implementation of the  
28 conservation and mitigation measures listed below would address these impacts, these are not  
29 anticipated to reduce the impacts to a level considered not adverse.

30 **CEQA Conclusion:** In general, Alternative 2A would reduce migration conditions for winter-run  
31 Chinook salmon relative to the Existing Conditions.

### 32 **Upstream of the Delta**

33 Flows in the Sacramento River upstream of Red Bluff were examined during the July through  
34 November juvenile emigration period. Flows under A2A\_LL1 for juvenile migrants would generally  
35 be similar to flows under Existing Conditions, except during August and November, in which flows  
36 would be up to 24% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
37 These reductions would not be large or frequent enough to cause biologically meaningful effects on  
38 juvenile emigration conditions.

39 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
40 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
41 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
42 *Fish Analysis*). Mean monthly water temperature would be up to 14% higher under Alternative 2A in  
43 July through October depending on month, water year type, and location. There would be no

1 differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative  
2 2A during November.

3 Flows under A2A\_LLT in the Sacramento River upstream of Red Bluff during December through  
4 August would generally be similar to flows under Existing Conditions, except during May and June,  
5 in which flows under A2A\_LLT would be up to 21% greater, and during August, in which flows  
6 would be up to 24% lower. These reductions in flow would not be frequent enough to cause  
7 biologically meaningful effects on adult migration conditions.

8 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
9 examined during the December through August winter-run upstream migration period (Appendix  
10 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
11 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
12 between Existing Conditions and Alternative 2A during December through June. Mean monthly  
13 water temperature would be up to 14% higher under Alternative 2A in July and August depending  
14 on month, water year type, and location.

### 15 **Through-Delta**

16 As described above, predation losses of migrating juvenile winter-run Chinook would increase at the  
17 five north Delta intakes, hypothetically ranging from less than 1% up to 12% that reach the north  
18 Delta. Through-Delta survival of emigrating juvenile winter-run Chinook salmon averaged across all  
19 years would decrease slightly compared to Existing Conditions (1.9% lower, a 5% relative decrease  
20 for all years) (Table 11-2A-16).

21 For migrating adults, olfactory cues, based on the proportion of Sacramento River flows, would be  
22 similar (<10% difference) to Existing Conditions during the winter-run Chinook salmon migration  
23 period December to February (Table 11-2A-17). For further discussion of this topic see the analysis  
24 for Alternative 1A.

### 25 **Summary of CEQA Conclusion**

26 Overall, Alternative 2A would significantly affect the migration conditions for juvenile or adult  
27 winter-run Chinook salmon, relative to the Existing Conditions. Alternative 2A would cause higher  
28 water temperatures in the Sacramento River upstream of the Delta relative to the Existing  
29 Conditions during a substantial portion of winter-run Chinook salmon juvenile and adult migration  
30 periods. There would be no effect of Alternative 2A on flows during the juvenile or adult winter-run  
31 Chinook salmon migration periods. Through-Delta survival of emigrating juveniles is expected to be  
32 substantially reduced, compared to Existing Conditions. There would be no effect of Alternative 2A  
33 on adult olfactory cues in the Delta.

34 Implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce  
35 them to a level considered less than significant. Although implementation of *CM6 Channel Margin*  
36 *Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be  
37 located near the intakes and therefore would not fully compensate for the lost habitat. Additionally,  
38 implementation of this measure would not fully address predation losses. *CM15 Localized Reduction*  
39 *of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness  
40 such that it is considered to have no demonstrable effect. Conservation measures that address  
41 habitat and predation losses, therefore, would potentially minimize impacts to some extent but not

1 to a less than significant level. Consequently, as a result of these changes in migration conditions,  
2 this impact is significant and unavoidable.

3 Applicable conservation measures are briefly described below and full descriptions are found in  
4 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
5 Reduction of Predatory Fishes (Predator Control) (CM15).

6 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
7 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
8 habitats on the waterside side of levees along channels that provide rearing and outmigration  
9 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
10 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
11 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
12 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
13 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
14 margin enhancement would be performed only along channels that provide rearing and  
15 outmigration habitat for juvenile salmonids. These include channels that are protected by  
16 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
17 among several others.

18 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
19 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
20 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
21 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
22 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
23 Therefore, this conservation measure is not intended to entirely remove predators at any  
24 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
25 conservation measure would also not remove piscivorous birds. Because of uncertainties  
26 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
27 projects and research actions coupled with an adaptive management and monitoring program to  
28 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
29 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
30 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

31 This impact is a result of the specific reservoir operations and resulting flows associated with this  
32 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
33 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
34 change the alternative, thereby making it a different alternative than that which has been modeled  
35 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
36 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
37 severity of the impact though not necessarily to a less-than-significant level.

38 **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**  
39 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
40 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

41 Although analysis conducted as part of the EIR/EIS determined that Alternative 2A would have  
42 significant and unavoidable adverse effects on migration habitat, this conclusion was based on  
43 the best available scientific information at the time and may prove to have been over- or  
44 understated. Upon the commencement of operations of CM1 and continuing through the life of

1 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
2 whether such effects would be as extensive as concluded at the time of preparation of this  
3 document and to determine any potentially feasible means of reducing the severity of such  
4 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
5 consistent with the operational framework for Alternative 2A.

6 The development and implementation of any mitigation actions shall be focused on those  
7 incremental effects attributable to implementation of Alternative 2A operations only.  
8 Development of mitigation actions for the incremental impact on migration habitat attributable  
9 to climate change/sea level rise are not required because these changed conditions would occur  
10 with or without implementation of Alternative 2A.

11 **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**  
12 **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

13 Following commencement of initial operations of CM1 and continuing through the life of the  
14 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
15 modified operations could reduce impacts to migration habitat under Alternative 2A. The  
16 analysis required under this measure may be conducted as a part of the Adaptive Management  
17 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

18 **Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement**  
19 **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration**  
20 **Conditions Consistent with CM1**

21 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run  
22 Chinook salmon habitat, the BDCP proponents will consult with FWS and the Department of Fish  
23 and Wildlife to identify and implement any feasible operational means to minimize effects on  
24 migration habitat. Any such action will be developed in conjunction with the ongoing monitoring  
25 and evaluation of habitat conditions required by Mitigation Measure AQUA-42a.

26 If feasible means are identified to reduce impacts on migration habitat consistent with the  
27 overall operational framework of Alternative 2A without causing new significant adverse  
28 impacts on other covered species, such means shall be implemented. If sufficient operational  
29 flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under  
30 Alternative 2A operations, achieving further impact reduction pursuant to this mitigation  
31 measure would not be feasible under this Alternative, and the impact on winter-run Chinook  
32 salmon would remain significant and unavoidable.

33 **Restoration and Conservation Measures**

34 Alternative 2A has the same restoration and conservation measures as Alternative 1A. Because no  
35 substantial differences in effects are anticipated anywhere in the affected environment under  
36 Alternative 2A compared to those described in detail for Alternative 1A, the effects described for  
37 winter-run Chinook salmon under Alternative 1A (Impact AQUA-43 through AQUA-54) also  
38 appropriately characterize effects under Alternative 2A.

39 The following impacts are those presented under Alternative 1A that are identical for Alternative  
40 2A.

- 1       **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
2       **(Winter-Run ESU)**
- 3       **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
4       **Salmon (Winter-Run ESU)**
- 5       **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
6       **ESU)**
- 7       **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
8       **ESU) (CM12)**
- 9       **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
10       **(Winter-Run ESU) (CM13)**
- 11       **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
12       **Run ESU) (CM14)**
- 13       **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
14       **(Winter-Run ESU) (CM15)**
- 15       **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
16       **(CM16)**
- 17       **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
18       **(CM17)**
- 19       **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
20       **(CM18)**
- 21       **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
22       **ESU) (CM19)**
- 23       **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
24       **(Winter-Run ESU) (CM21)**

25       **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
26       adverse effect, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the  
27       reasons identified for Alternative 1A. Specifically for AQUA-44, the effects of contaminants on  
28       winter-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be  
29       adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

30       **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
31       less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for  
32       Alternative 1A, and no mitigation is required.

## 1 **Spring-Run Chinook Salmon**

### 2 **Construction and Maintenance of CM1**

#### 3 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 4 **(Spring-Run ESU)**

5 The potential effects of construction of the water conveyance facilities on spring-run Chinook  
6 salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except that  
7 Alternative 2A could potentially include two different intakes than under Alternative 1A. This would  
8 convert about 11,350 lineal feet of existing shoreline habitat into intake facility structures and  
9 would require about 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would  
10 convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. The effects related  
11 to temporary increases in turbidity, accidental spills, underwater noise, in-water work activities,  
12 and disturbance of contaminated sediments would be similar to Alternative 1A and the same  
13 environmental commitments and mitigation measures (described under Impact AQUA-1 for delta  
14 smelt and in Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize  
15 potential effects.

16 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-55, environmental commitments and  
17 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
18 not be adverse for spring-run Chinook salmon.

19 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-55, the impact of the construction of  
20 water conveyance facilities on spring-run Chinook salmon would not be significant except for  
21 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
22 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

#### 23 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 24 **of Pile Driving and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
26 Alternative 1A.

#### 27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
30 Alternative 1A.

#### 31 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 32 **(Spring-Run ESU)**

33 The maintenance-related effects of Alternative 2A would be identical for all four Chinook salmon  
34 ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the discussion of these  
35 effects for winter-run Chinook for Alternative 1A (Impact AQUA-38). Therefore, the impact would  
36 not be adverse for spring-run Chinook salmon.

1 **Water Operations of CM1**

2 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
3 **ESU)**

4 ***Water Exports from SWP/CVP South Delta Facilities***

5 Losses under Alternative 2A would decrease by approximately 54% compared to NAA averaged  
6 across all years (Table 11-2A-8). Annual average loss of juvenile spring-run Chinook salmon under  
7 Alternative 2A would be approximately 18,000 fish for the combined SWP and CVP south Delta  
8 facilities. Losses would be greatest in dry (~16,000 fish) and wet years (~12,800 fish), and lowest in  
9 below normal years (~5,200 fish). Entrainment reductions under Alternative 2A would be greater in  
10 wetter years, ranging from a 5% decrease in dry years up to 86% decrease in wet years compared to  
11 Existing Conditions (Table 11-2A-18). Pre-screen losses, typically attributed to predation, would  
12 also decrease commensurate with entrainment reductions.

13 The proportion of the annual spring-run Chinook population (assumed to be 750,000 juveniles  
14 approaching the Delta) lost at the south Delta facilities across all years averaged 5.1–5.3% under  
15 NAA, and would decrease to 2.4% under Alternative 2A.

16 **Table 11-2A-18. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index at the**  
17 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 2A**

Water Year Type	Absolute Difference (Percent Difference) <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-79,450 (-86%)	-78,649 (-86%)
Above Normal	-19,700 (-66%)	-16,431 (-62%)
Below Normal	-1,919 (-27%)	-1,105 (-17%)
Dry	-1,760 (-10%)	-848 (-5%)
Critical	-916 (-9%)	-2,311 (-20%)
All Years	-21,554 (-55%)	-20,586 (-54%)

Shading indicates 10% or greater increased entrainment.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data.

18

19 ***Water Exports from SWP/CVP North Delta Intake Facilities***

20 The impacts from the proposed SWP/CVP north Delta intakes on spring-run Chinook salmon would  
21 be the same as described for Impact AQUA-57 for spring-run Chinook Salmon under Alternative 1A.  
22 State-of-the-art fish screens operated with an adaptive management plan would be expected to  
23 eliminate entrainment risk for juvenile spring-run Chinook salmon to these intakes.

24 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

25 The effects would be the same as described in Impact AQUA-39 for Alternative 1A. Entrainment and  
26 impingement effects on juvenile spring-run Chinook salmon would be minimal for Alternative 2A  
27 because intakes would have state-of-the-art screens installed.

1 **NEPA Effects:** Under Alternative 2A, entrainment of juvenile spring-run Chinook salmon at the south  
2 Delta facilities was estimated to be similar to or somewhat lower than NAA across all water years  
3 (considering the all-year salvage density results). Therefore, the effect would not be adverse.

4 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
5 SWP/CVP south Delta facilities would result in an overall decrease in entrainment for juvenile  
6 spring-run Chinook salmon, although there is substantial variation among water year types (Table  
7 11-2A-8). However, with the added entrainment risks at the proposed north Delta facilities the  
8 overall entrainment rates are expected to be similar for Alternative 2A as Existing Conditions.  
9 Consequently, the impact of water operations on entrainment of juvenile Chinook salmon (spring-  
10 run ESU) is considered less than significant, and no mitigation would be required.

11 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
12 **Chinook Salmon (Spring-Run ESU)**

13 In general, the effects of Alternative 2A on spawning and egg incubation habitat for spring-run  
14 Chinook salmon relative to NAA are uncertain.

15 **Sacramento River**

16 Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon  
17 spawning and incubation period (September through January) under A2A\_LLT would be greater  
18 than, similar to, and lower than those under NAA depending on month and water year type  
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT during  
20 December and January would be greater than or similar to those under NAA regardless of water  
21 year type. Flows during September would be up to 17% greater than or similar to those under NAA  
22 in wet, dry, and critical years, up to 15% lower in above normal and below normal years, but similar  
23 when all years are combined. Flows during October would not be different from those under NAA in  
24 all water years except below normal years, when flows are 6% lower. Flows in November would be  
25 similar or lower (up to -17%) depending on water year type.

26 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam  
27 during the spring-run spawning and egg incubation period (September through January). Storage  
28 under A2A\_LLT would be similar to, or greater than storage under NAA in all water year types  
29 (Table 11-2A-19).

30 **Table 11-2A-19. Difference and Percent Difference in September Water Storage Volume (thousand**  
31 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-286 (-9%)	226 (8%)
Above Normal	-346 (-11%)	269 (10%)
Below Normal	-229 (-8%)	125 (5%)
Dry	-172 (-7%)	339 (17%)
Critical	-137 (-12%)	245 (30%)

32

33 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
34 examined during the September through January spring-run Chinook salmon spawning period  
35 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*

1 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
2 temperature between NAA and Alternative 2A in any month or water year type throughout the  
3 period at either location.

4 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
5 determined for each month (May through September at Bend Bridge and October through April at  
6 Red Bluff) and year of the 82-year modeling period (Table 11-2A-10). The combination of number of  
7 days and degrees above the 56°F threshold were further assigned a “level of concern” as defined in  
8 Table 11-2A-11. Differences between baselines and Alternative 2A in the highest level of concern  
9 across all months and all 82 modeled years are presented in Table 11-2A-12 for Bend Bridge and in  
10 Table 11-2A-20 for Red Bluff. There would be no difference in levels of concern between NAA and  
11 Alternative 2A at Bend Bridge. At Red Bluff, there would be 1 (2%) and 4 (24%) more years with a  
12 “red” and “orange” level of concern, respectively, under Alternative 2A. There would be 5 (71%)  
13 fewer years with a “yellow” level of concern.

14 **Table 11-2A-20. Differences between Baseline and Alternative 2A Scenarios in the Number of**  
15 **Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**  
16 **Sacramento River at Red Bluff, October through April**

Level of Concern <sup>a</sup>	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Red	37 (308%)	1 (2%)
Orange	11 (183%)	4 (24%)
Yellow	-6 (-46%)	-5 (-71%)
None	-42 (-82%)	0 (0%)

<sup>a</sup> For definitions of levels of concern, see Table 11-2A-11.

17

18 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
19 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
20 degree-days under Alternative 2A would be up to 12% lower than those under NAA during May and  
21 June and up to 16% higher during July through September (Table 11-2A-13). At Red Bluff, total  
22 degree-days under Alternative 2A would differ from those under NAA during October, November,  
23 and March (6%, 8%, and 9% higher, respectively), 5% lower during April, and similar during  
24 remaining months, for all years combined (Table 11-2A-21).

1  
2  
3

**Table 11-2A-21. Differences between Baseline and Alternative 2A Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Red Bluff, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
October	Wet	1,277 (497%)	108 (8%)
	Above Normal	526 (202%)	49 (7%)
	Below Normal	825 (395%)	119 (13%)
	Dry	1,153 (235%)	82 (5%)
	Critical	909 (152%)	-14 (-1%)
	All	4,690 (258%)	344 (6%)
November	Wet	97 (9,700%)	7 (8%)
	Above Normal	75 (NA)	14 (23%)
	Below Normal	59 (NA)	11 (23%)
	Dry	163 (2,038%)	12 (8%)
	Critical	105 (2,625%)	-5 (-4%)
	All	499 (3,838%)	39 (8%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	9 (NA)	0 (0%)
	Above Normal	5 (NA)	1 (25%)
	Below Normal	36 (400%)	15 (50%)
	Dry	63 (450%)	-1 (-1%)
	Critical	25 (2,500%)	-2 (-7%)
	All	138 (575%)	13 (9%)
April	Wet	260 (226%)	-1 (0%)
	Above Normal	208 (149%)	-21 (-6%)
	Below Normal	228 (289%)	-2 (-1%)
	Dry	261 (140%)	-59 (-12%)
	Critical	152 (1,267%)	1 (1%)
	All	1,109 (208%)	-82 (-5%)

NA = could not be calculated because the denominator was 0.

4

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A2A\_LLT would be similar to mortality under NAA in dry and critical years, but greater in wet (13% greater), above normal (9% greater), and below normal (28% greater) water years (Table 11-2A-22). Absolute scale increases of 3% of the spring-run population under wet and above normal water years would be negligible to the overall population. However, the 12% increase in mortality in below normal years would be a small negative effect on the spring-run population. Combining all water years, there would be no effect of Alternative 2A on egg mortality (3% absolute change).

**Table 11-2A-22. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	18 (178%)	3 (13%)
Above Normal	25 (188%)	3 (9%)
Below Normal	41 (345%)	12 (28%)
Dry	56 (287%)	0 (0%)
Critical	22 (30%)	0 (0%)
All	32 (143%)	3 (7%)

SacEFT predicts that there would be a minimal (<5%) difference in the percentage of years with good spawning availability, measured as weighted useable area, between A2A\_LLT and NAA (Table 11-2A-23). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A2A\_LLT relative to NAA (Table 11-2A-23). SacEFT predicts that there would be a 26% decrease (9% decrease on absolute scale) in the percentage of years with good (lower) egg incubation conditions under A2A\_LLT relative to NAA. SacEFT predicts that there would be a 6% decrease (2% decrease on absolute scale) in the percentage of years with good (lower) redd dewatering risk under A2A\_LLT relative to NAA.

**Table 11-2A-23. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Spawning WUA	-22 (-31%)	-1 (-2%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-61 (-71%)	-9 (-26%)
Redd Dewatering Risk	-17 (-35%)	-2 (-6%)
Juvenile Rearing WUA	1 (5%)	1 (5%)
Juvenile Stranding Risk	-8 (-42%)	-3 (-21%)

WUA = Weighted Usable Area.

There is an apparent discrepancy in results of the SacEFT model and Reclamation egg mortality model with regard to conditions for spring-run salmon eggs. SacEFT predicts that egg incubation habitat would decrease (9% absolute scale decrease) and the Reclamation egg mortality model predicts that overall egg mortality would be unaffected by Alternative 2A, except in below normal water years. The SacEFT uses mid-August through early March as the egg incubation period, based

1 on Vogel and Marine (1991), and the reach between ACID Dam and Battle Creek for redd locations.  
 2 The Reclamation egg mortality model uses the number of days after Julian week 33 (mid-August)  
 3 that it takes to accumulate 750 temperature units to hatching and another 750 temperature units to  
 4 emergence. Temperatures units are calculated by subtracting 32°F from daily river temperature and  
 5 are computed on a daily basis. As a result, egg incubation duration is generally mid-August through  
 6 January, but is dependent on river temperature. The Reclamation model uses the reach between  
 7 ACID Dam and Jelly’s Ferry (approximately 5 river miles downstream of Battle Creek), which  
 8 includes 95% of Sacramento River spawning locations based on 2001–2004 redd survey data  
 9 (Reclamation 2008). These differences in egg incubation period and location likely account for the  
 10 difference between model results. Although the SacEFT model has been peer-reviewed, the  
 11 Reclamation egg mortality model has been extensively reviewed and used in prior biological  
 12 assessments and BiOps. Therefore, both results are considered valid and were considered in  
 13 drawing conclusions about spring-run egg mortality in the Sacramento River.

14 **Clear Creek**

15 Flows in Clear Creek were examined during the spring-run Chinook salmon spawning and egg  
 16 incubation period (September through January). Flows under A2A\_LLT would be similar to or  
 17 greater than flows under NAA throughout the period for all water year types (Appendix 11C, *CALSIM*  
 18 *II Model Results utilized in the Fish Analysis*).

19 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
 20 comparing the magnitude of flow reduction each month over the incubation period compared to the  
 21 flow in September when spawning is assumed to occur. The greatest reduction in flows under  
 22 A2A\_LLT would be the same as that under NAA in all water year types (Table 11-2A-24).

23 Water temperatures were not modeled in Clear Creek.

24 **Table 11-2A-24. Difference and Percent Difference in Greatest Monthly Reduction (Percent**  
 25 **Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September**  
 26 **through January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

28 **Feather River**

29 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)  
 30 where spring-run Chinook primarily spawn during September through January (Appendix 11C,  
 31 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would not differ from

1 NAA because minimum Feather River flows are included in the FERC settlement agreement and  
2 would be met for all model scenarios (California Department of Water Resources 2006).

3 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam  
4 during the spring-run spawning and egg incubation period. Storage volume at the end of September  
5 under A2A\_LLT would be similar to or up to 16% greater than storage under NAA depending on  
6 water year type (Table 11-2A-25).

7 **Table 11-2A-25. Difference and Percent Difference in September Water Storage Volume (thousand**  
8 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-929 (-32%)	85 (5%)
Above Normal	-859 (-36%)	-68 (-4%)
Below Normal	-559 (-28%)	50 (4%)
Dry	-192 (-14%)	161 (16%)
Critical	-71 (-7%)	117 (15%)

9  
10 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
11 comparing the magnitude of flow reduction each month over the egg incubation period compared to  
12 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
13 during October through January were identical among A2A\_LLT and NAA (Appendix 11C, *CALSIM II*  
14 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 2A on  
15 redd dewatering in the Feather River low-flow channel.

16 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream  
17 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water*  
18 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
19 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in  
20 any month or water year type throughout the period.

21 The percent of months exceeding the 56°F temperature threshold in the Feather River above  
22 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table  
23 11-2A-26). The percent of months exceeding the threshold under Alternative 2A would generally be  
24 lower (up to 11% lower on an absolute scale) than the percent under NAA during September,  
25 October and November and similar during other months.

1 **Table 11-2A-26. Differences between Baseline and Alternative 2A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River above Thermalito Afterbay Exceed the 56°F Threshold, September through January**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LLT</b>					
September	0 (0%)	0 (0%)	6 (7%)	17 (24%)	35 (85%)
October	53 (239%)	51 (683%)	48 (780%)	44 (1,800%)	31 (1,250%)
November	54 (2,200%)	47 (3,800%)	41 (3,300%)	27 (NA)	14 (NA)
December	4 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>NAA vs. A2A_LLT</b>					
September	0 (0%)	-1 (-1%)	-1 (-1%)	-6 (-6%)	-7 (-9%)
October	-11 (-13%)	-7 (-11%)	-1 (-2%)	-2 (-5%)	-6 (-16%)
November	-10 (-15%)	-11 (-19%)	-7 (-15%)	-5 (-15%)	-11 (-45%)
December	0 (0%)	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4  
 5 Total degree-days exceeding 56°F were summed by month and water year type above Thermalito  
 6 Afterbay (low-flow channel) during September through January (Table 11-2A-27). Total degree-  
 7 months would be similar between NAA and Alternative 2A during September and January, lower  
 8 during October and November, and 20% higher during December.

1 **Table 11-2A-27. Differences between Baseline and Alternative 2A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 56°F in the Feather River above Thermalito Afterbay, September through January**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
September	Wet	29 (27%)	4 (3%)
	Above Normal	14 (33%)	4 (8%)
	Below Normal	39 (65%)	8 (9%)
	Dry	70 (101%)	-18 (-11%)
	Critical	50 (77%)	-12 (-9%)
	All	202 (59%)	-14 (-2%)
October	Wet	84 (1,680%)	-12 (-12%)
	Above Normal	31 (310%)	-4 (-9%)
	Below Normal	52 (743%)	-2 (-3%)
	Dry	83 (1,186%)	3 (3%)
	Critical	33 (413%)	-8 (-16%)
	All	282 (762%)	-24 (-7%)
November	Wet	56 (NA)	0 (0%)
	Above Normal	24 (800%)	-1 (-4%)
	Below Normal	26 (2,600%)	-8 (-23%)
	Dry	48 (NA)	-3 (-6%)
	Critical	24 (NA)	-4 (-14%)
	All	177 (4,425%)	-17 (-9%)
December	Wet	1 (NA)	0 (0%)
	Above Normal	2 (NA)	1 (100%)
	Below Normal	3 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	6 (NA)	1 (20%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Available analytical tools show conflicting results regarding the temperature effects of  
 6 relatively small changes in predicted summer and fall flows in the Sacramento River. Several models  
 7 (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in upstream  
 8 conditions as a result of Alternative 2A. However, one model, SacEFT, shows adverse effects under  
 9 some conditions. After extensive investigation of these results, they appear to be a function of high  
 10 model sensitivity to relatively small changes in estimated upstream conditions, which may or may  
 11 not accurately predict adverse effects. The new NDD structures allow for spring time deliveries of  
 12 water south of the Delta that are currently constrained under the NAA. For this reason, additional  
 13 spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was  
 14 modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta

1 Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion,  
2 Alternative 2A modeling results support a finding that effects are uncertain. Modeled results are  
3 mixed and operations that match the CALSIM modeling are not assured. Model results will be  
4 submitted to independent peer review to confirm that adverse effects are not reasonably anticipated  
5 to occur.

6 There would be no effects of Alternative 2A on spawning and egg incubation conditions in Clear  
7 Creek and no or beneficial effects in the Feather River.

8 **CEQA Conclusion:** In general, Alternative 2A would not affect spawning and egg incubation habitat  
9 for spring-run Chinook salmon relative to the Existing Conditions.

#### 10 **Sacramento River**

11 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
12 salmon spawning and incubation period (September through January). Flows during September  
13 would be up to 55% greater than or similar to those under Existing Conditions in wet, above normal,  
14 and critical years and up to 17% lower than those under Existing Conditions in below normal and  
15 dry water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
16 A2A\_LL2 during October and January would be up to 10% greater than or similar to those under  
17 Existing Conditions depending on water year type. Flows during November would be 3% to 13%  
18 lower than those under Existing Conditions depending on water year type. Flows during December  
19 would be up to 7% greater than or similar to those under Existing Conditions in all water years  
20 except wet year, in which flows are 8% lower than under Existing Conditions.

21 Shasta Reservoir Storage volume at the end of September would be 7% to 12% lower under  
22 A2A\_LL2 relative to Existing Conditions (Table 11-2A-19).

23 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
24 examined during the September through January spring-run Chinook salmon spawning period  
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
26 *utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 2A during September and  
27 October would be up to 10% and 7% greater, respectively, than those under Existing Conditions, but  
28 not different in other months during the period. At Bend Bridge, temperatures under Alternative 2A  
29 during September and October would be up to 9% and 6% greater, respectively, than those under  
30 Existing Conditions, but not different in other months during the period.

31 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
32 determined for each month (May through September at Bend Bridge and October through April at  
33 Red Bluff) and year of the 82-year modeling period (Table 11-2A-10). The combination of number of  
34 days and degrees above the 56°F threshold were further assigned a “level of concern” as defined in  
35 Table 11-2A-11. Differences between baselines and Alternative 2A in the highest level of concern  
36 across all months and all 82 modeled years are presented in Table 11-2A-12 for Bend Bridge and in  
37 Table 11-2A-20 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years  
38 with a “red” level of concern under Alternative 2A relative to Existing Conditions. At Red Bluff, there  
39 would be 308% and 183% increases in the number of years with “red” and “orange” levels of  
40 concern, respectively, under Alternative 2A relative to Existing Conditions.

41 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
42 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
43 degree-days under Alternative 2A would be up to 1135% to 313% higher than those under Existing

1 Conditions depending on the month (Table 11-2A-13). At Red Bluff, total degree-days under  
2 Alternative 2A would be 208% to 3838% higher than those under Existing Conditions during  
3 October, November, March, and April, and similar during December through February (Table 11-2A-  
4 21).

5 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
6 Sacramento River under A2A\_LLT would be 30% to 345% greater than mortality under Existing  
7 Conditions depending on water year type (Table 11-2A-22).

8 SacEFT predicts that there would be a 31% decrease in the percentage of years with good spawning  
9 availability, measured as weighted usable area, under A2A\_LLT relative to Existing Conditions  
10 (Table 11-2A-23). SacEFT predicts that there would be no difference in the percentage of years with  
11 good (lower) redd scour risk under A2A\_LLT relative to Existing Conditions. SacEFT predicts that  
12 there would be a 71% decrease in the percentage of years with good (lower) egg incubation  
13 conditions under A2A\_LLT relative to Existing Conditions, respectively. SacEFT predicts that there  
14 would be a 35% decrease in the percentage of years with good (lower) redd dewatering risk under  
15 A2A\_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation  
16 conditions for spring-run Chinook salmon would be poor relative to Existing Conditions.

#### 17 **Clear Creek**

18 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
19 (September through January) under A2A\_LLT would generally be similar to or greater than flows  
20 under Existing Conditions except in critical years during September through November (6% to 29%  
21 reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
23 comparing the magnitude of flow reduction each month over the incubation period compared to the  
24 flow in September when spawning is assumed to occur. The greatest reduction in flows under  
25 A2A\_LLT would be similar to or lower magnitude than that under Existing Conditions in wet and  
26 below normal water years (Table 11-2A-24). The greatest reduction in flows under A2A\_LLT would  
27 be 27% to 67% lower (more negative) than Existing Conditions in above normal, dry, and critical  
28 years.

29 Water temperatures were not modeled in Clear Creek.

#### 30 **Feather River**

31 Flows in the Feather River low-flow channel under A2A\_LLT are not different from Existing  
32 Conditions during the spring-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be  
34 equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

35 Oroville Reservoir storage volume at the end of September would be 7% to 36% lower under  
36 A2A\_LLT relative to Existing Conditions depending on water year type (Table 11-2A-25).

37 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
38 comparing the magnitude of flow reduction each month over the incubation period compared to the  
39 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
40 during October through January were identical between A2A\_LLT and Existing Conditions

1 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no  
2 effect of Alternative 2A on redd dewatering in the Feather River low-flow channel.

3 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream  
4 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water  
5 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

6 Temperatures under Alternative 2A would be 6% to 11% greater than those under Existing  
7 Conditions in all months during the period.

8 The percent of months exceeding the 56°F temperature threshold in the Feather River above  
9 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table  
10 11-2A-26). The percent of months exceeding the threshold under Alternative 2A would be similar to  
11 or up to 54% higher (absolute scale) than under Existing Conditions during September through  
12 November. There would be little to no difference in the percent of months exceeding the threshold  
13 between Existing Conditions and Alternative 2A during December and January.

14 Total degree-days exceeding 56°F were summed by month and water year type above Thermalito  
15 Afterbay (low-flow channel) during September through January (Table 11-2A-27). Total degree-  
16 months exceeding the threshold under Alternative 2A would be 59% to 4425% greater than those  
17 under Existing Conditions during September through November. There would be minimal to no  
18 difference in total degree-months between Existing Conditions and Alternative 2A during December  
19 and January.

## 20 **Summary of CEQA Conclusion**

21 Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between  
22 the CEQA baseline and Alternative 2A could be significant because, when compared to the CEQA  
23 baseline, the alternative could substantially reduce suitable spawning habitat and substantially  
24 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth  
25 above, which is directly related to the inclusion of climate change effects in Alternative 2A. There are  
26 biologically meaningful flow reductions and temperature increases in the Sacramento River under  
27 Alternative 2A, relative to Existing Conditions, that would lead to increased egg mortality and  
28 overall reduced habitat conditions in spring-run spawning and egg incubation habitat conditions.  
29 Flows in the Feather River low-flow channel do not differ between Alternative 2A and Existing  
30 Conditions. However, water temperature analyses in the Feather River low-flow channel using  
31 NMFS thresholds indicate that there would be substantial negative effects on temperature  
32 conditions during spring-run Chinook salmon spawning and egg incubation.

33 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
34 change, future water demands, and implementation of the alternative. The analysis described above  
35 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
36 the alternative from those of sea level rise, climate change and future water demands using the  
37 model simulation results presented in this chapter. However, the increment of change attributable  
38 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
39 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
40 implementation period, which does include future sea level rise, climate change, and water  
41 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
42 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
43 effect of the alternative from those of sea level rise, climate change, and water demands.

1 The additional comparison of CALSIM flow and reservoir storage outputs between Existing  
2 Conditions in the late long-term implementation period and Alternative 2A indicates that flows and  
3 reservoir storage in the locations and during the months analyzed above would generally be similar  
4 between future conditions without the BDCP (NAA) and Alternative 2A. This indicates that the  
5 differences between Existing Conditions and Alternative 2A found above would generally be due to  
6 climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA  
7 conclusion regarding Alternative 2A, if adjusted to exclude sea level rise and climate change, is  
8 similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on  
9 spawning and egg incubation habitat for spring-run Chinook salmon. This impact is found to be less  
10 than significant and no mitigation is required.

11 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-  
12 Run ESU)**

13 In general, Alternative 2A would not affect the quantity and quality of rearing habitat for fry and  
14 juvenile spring-run Chinook salmon relative to NAA.

15 ***Sacramento River***

16 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
17 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
18 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows between December  
19 and March under A2A\_LLT would generally be similar to or greater than those under NAA. Flows  
20 during November would be up to 17% lower under A2A\_LLT than under NAA.

21 As reported in Impact AQUA-40, May Shasta storage volume under A2A\_LLT would be similar to or  
22 greater than storage under NAA for all water year types (Table 11-2A-9).

23 As reported in Impact AQUA-58, September Shasta storage volume would be similar to or greater  
24 than storage under NAA in all water year types (Table 11-2A-19).

25 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
26 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
27 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the  
28 Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
29 NAA and Alternative 2A in any month or water year type throughout the period at either location.

30 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under  
31 A2A\_LLT would be similar to that under NAA (Table 11-2A-23). However, the percentage of years  
32 with good (lower) juvenile stranding risk conditions under A2A\_LLT would be 21% lower than  
33 under NAA, although this would be a 3% difference on an absolute scale.

34 SALMOD predicts that spring-run smolt equivalent habitat-related mortality would be 6% lower  
35 under A2A\_LLT than NAA.

36 ***Clear Creek***

37 Flows in Clear Creek below Whiskeytown during the November through March spring-run rearing  
38 period under A2A\_LLT would generally be similar to or greater than flows under NAA, except for  
39 critical years in February and below normal years in March in which flows would be 6% to 8%  
40 lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Water temperatures were not modeled in Clear Creek.

2 **Feather River**

3 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
4 channel) during November through June were reviewed to determine flow-related effects on larval  
5 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
6 Analysis*). Relatively constant flows in the low flow channel throughout this period under A2A\_LLT  
7 would not differ from those under NAA. In the high flow channel, flows under A2A\_LLT would be  
8 mostly similar to or greater than flows under NAA during November through June with few  
9 exceptions during which flows would be up to 12% lower under A2A\_LLT.

10 May Oroville storage under A2A\_LLT would be similar to storage under NAA (Table 11-2A-28).

11 As reported in Impact AQUA-58, September Oroville storage volume would be similar to or up to 5%  
12 lower than under NAA depending on water year type (Table 11-2A-25).

13 **Table 11-2A-28. Difference and Percent Difference in May Water Storage Volume (thousand acre-  
14 feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-78 (-2%)	-32 (-1%)
Above Normal	-205 (-6%)	-49 (-1%)
Below Normal	-404 (-12%)	-51 (-2%)
Dry	-576 (-21%)	-56 (-3%)
Critical	-272 (-15%)	44 (3%)

15

16 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
17 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
18 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in  
19 the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
20 between NAA and Alternative 2A in any month or water year type throughout the period at either  
21 location.

22 The percent of months exceeding the 63°F temperature threshold in the Feather River above  
23 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-2A-  
24 29). The percent of months exceeding the threshold under Alternative 2A would generally be similar  
25 to or lower (up to 23% lower on an absolute scale) than the percent under NAA.

1 **Table 11-2A-29. Differences between Baseline and Alternative 2A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River above Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LL1</b>					
May	2 (NA)	2 (NA)	0 (NA)	0 (NA)	0 (NA)
June	26 (47%)	27 (100%)	23 (475%)	7 (NA)	1 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	48 (122%)
August	0 (0%)	12 (14%)	36 (62%)	51 (178%)	40 (400%)
<b>NAA vs. A2A_LL1</b>					
May	-4 (-60%)	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)
June	-7 (-8%)	-23 (-30%)	-19 (-39%)	-14 (-65%)	-4 (-75%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-6 (-7%)
August	0 (0%)	0 (0%)	-5 (-5%)	-2 (-3%)	-7 (-13%)

4  
 5 Total degree-days exceeding 63°F were summed by month and water year type above Thermalito  
 6 Afterbay (low-flow channel) during May through August (Table 11-2A-30). Total degree-months  
 7 under Alternative 2A would be similar to or lower than those under NAA depending on the month  
 8 except for July when it would be 3% higher.

1 **Table 11-2A-30. Differences between Baseline and Alternative 2A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 63°F in the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
May	Wet	1 (NA)	0 (0%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	3 (NA)	-1 (-25%)
	All	7 (NA)	-1 (-13%)
June	Wet	24 (160%)	-5 (-11%)
	Above Normal	12 (86%)	-5 (-16%)
	Below Normal	17 (131%)	-5 (-14%)
	Dry	30 (130%)	-3 (-5%)
	Critical	20 (333%)	-5 (-16%)
	All	104 (146%)	-22 (-11%)
July	Wet	44 (37%)	3 (2%)
	Above Normal	20 (45%)	0 (0%)
	Below Normal	28 (47%)	0 (0%)
	Dry	41 (58%)	5 (5%)
	Critical	38 (73%)	6 (7%)
	All	171 (49%)	14 (3%)
August	Wet	43 (48%)	10 (8%)
	Above Normal	21 (84%)	3 (7%)
	Below Normal	31 (82%)	2 (3%)
	Dry	47 (118%)	-6 (-6%)
	Critical	32 (76%)	-8 (-10%)
	All	174 (74%)	1 (0.2%)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because habitat would  
 6 not be substantially reduced. There would be no substantial effects of Alternative 2A on rearing  
 7 habitat for spring-run Chinook salmon in the Sacramento and Feather Rivers or in Clear Creek.  
 8 Biological models, including SacEFT and SALMOD, support these findings.

9 **CEQA Conclusion:** In general, under Alternative 2A water operations, the quantity and quality of  
 10 rearing habitat for fry and juvenile spring-run Chinook salmon would not be affected relative to  
 11 Existing Conditions (the CEQA baseline).

12 **Sacramento River**

13 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
 14 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
 15 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows between December  
 16 and March under A2A\_LLT would be generally similar to or greater than those under Existing  
 17 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during  
 18 November would be lower under A2A\_LLT than under Existing Conditions.

1 As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A2A\_LLT  
2 would be similar to Existing Conditions in wet, above normal, and below normal water years, but  
3 lower by 6% to 9% in dry and critical water years (Table 11-2A-9). As reported in Impact AQUA-58,  
4 storage volume at the end of September under A2A\_LLT would be 7% to 12% lower relative to  
5 Existing Conditions (Table 11-2A-19).

6 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
7 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
8 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
9 *Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water  
10 temperature between Existing Conditions and Alternative 2A in most months, except for 5% to 14%  
11 increases during July through October.

12 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under  
13 A2A\_LLT would be greater than that under Existing Conditions (Table 11-2A-23). The percentage of  
14 years with good (lower) juvenile stranding risk conditions under A2A\_LLT would be 42% lower  
15 than under Existing Conditions.

16 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A2A\_LLT would  
17 be 165% higher than under Existing Conditions.

#### 18 **Clear Creek**

19 Flows in Clear Creek during the November through March rearing period under A2A\_LLT would  
20 generally be similar to or greater than flows under Existing Conditions, except for critical years in  
21 November and December in which flows would be 6% lower (Appendix 11C, *CALSIM II Model*  
22 *Results utilized in the Fish Analysis*).

23 Water temperatures were not modeled in Clear Creek.

#### 24 **Feather River**

25 Relatively constant flows in the low flow channel throughout the November through June period  
26 under A2A\_LLT would not differ from those under Existing Conditions (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). In the high flow channel (at Thermalito Afterbay), flows  
28 under A2A\_LLT would be mostly lower (up to 45%) during November, December, and February and  
29 both higher and lower depending on water year type during March.

30 May Oroville storage volume under A2A\_LLT would be lower than Existing Conditions by 6% to 21%  
31 depending on water year type, except in wet years, in which storage would be similar to Existing  
32 Conditions (Table 11-2A-28).

33 As reported in Impact AQUA-58, September Oroville storage volume would be 7% to 36% lower  
34 under A2A\_LLT relative to Existing Conditions depending on water year type (Table 11-2A-25).

35 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
36 Thermalito Afterbay (high-flow channel) were evaluated during the November through June  
37 juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
38 *Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 2A  
39 would be 5% to 10% greater than those under Existing Conditions during November through March,  
40 but similar (<5% difference) during April through June.

1 The percent of months exceeding the 63°F temperature threshold in the Feather River above  
2 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-2A-  
3 29). The percent of months exceeding the threshold under Alternative 2A would be similar to those  
4 under Existing Conditions during May, but up to 51% greater during June through August.

5 Total degree-days exceeding 63°F were summed by month and water year type above Thermalito  
6 Afterbay (low-flow channel) during May through August (Table 11-2A-30). Total degree-months  
7 under Alternative 2A would be similar to those under Existing Conditions during May, but 49% to  
8 146% higher during June through August.

### 9 **Summary of CEQA Conclusion**

10 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between  
11 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
12 alternative could substantially reduce rearing habitat, contrary to the NEPA conclusion set forth  
13 above. Flows and temperatures in the Sacramento River would generally be unchanged under  
14 Alternative 2A relative to Existing Conditions, both SacEFT and SALMOD predict negative effects on  
15 juvenile rearing habitat. There would be no effects of Alternative 2A on flows in Clear Creek. Flows  
16 in the low-flow channel would be unchanged by Alternative 2A. However, flows in the high-flow  
17 channel would be mostly lower by up to 44% during the half of the fry and juvenile rearing period.  
18 Temperatures in both portions of the Feather River would experience increased water temperatures  
19 during substantial portions of the rearing period under Alternative 2A and NMFS temperature  
20 thresholds would be exceeded at a substantially higher frequency.

21 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
22 change, future water demands, and implementation of the alternative. The analysis described above  
23 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
24 the alternative from those of sea level rise, climate change and future water demands using the  
25 model simulation results presented in this chapter. However, the increment of change attributable  
26 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
27 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
28 implementation period, which does include future sea level rise, climate change, and water  
29 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
30 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
31 effect of the alternative from those of sea level rise, climate change, and water demands.

32 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
33 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
34 locations and during the months analyzed above would generally be similar between Existing  
35 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
36 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
37 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
38 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
39 therefore would not in itself result in a significant impact on rearing habitat for spring-run Chinook  
40 salmon. This impact is found to be less than significant and no mitigation is required.

1 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
2 **(Spring-Run ESU)**

3 In general, Alternative 2A would reduce migration conditions for spring-run Chinook salmon  
4 relative to NAA.

5 **Upstream of the Delta**

6 ***Sacramento River***

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through  
8 May juvenile Chinook salmon spring-run migration period. Flows under A2A\_LLT during December  
9 through May would always be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II*  
10 *Model Results utilized in the Fish Analysis*).

11 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
12 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,  
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
15 NAA and Alternative 2A in any month or water year type throughout the period.

16 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through  
17 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*  
18 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be similar to or  
19 greater than flows under NAA except during July and August (up to 15% lower depending on month  
20 and water year type).

21 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
22 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
25 NAA and Alternative 2A in any month or water year type throughout the period.

26 ***Clear Creek***

27 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
28 migration period under A2A\_LLT would generally be similar to or greater than flows under NAA  
29 except in critical years during February (6% lower), and in below normal years in March (6% lower)  
30 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
32 migration period under A2A\_LLT would generally be similar to or greater than flows under NAA  
33 with exceptions in critical water years during June (Appendix 11C, *CALSIM II Model Results utilized*  
34 *in the Fish Analysis*).

35 Water temperatures were not modeled in Clear Creek.

36 ***Feather River***

37 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
38 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,  
39 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to or

1 greater than flows under NAA in all months and water years except during November in above  
2 normal years (8% lower).

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
4 were examined during the November through May juvenile spring-run Chinook salmon migration  
5 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
6 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
7 temperature between NAA and Alternative 2A in any month or water year type throughout the  
8 period.

9 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
10 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
11 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT during April through  
12 June would be similar to or greater than flows under NAA. Flows under A2A\_LLT during July and  
13 August would generally be lower than flows under NAA by up to 44%.

14 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
15 were examined during the April through August adult spring-run Chinook salmon upstream  
16 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
17 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
18 mean monthly water temperature between NAA and Alternative 2A in any month or water year type  
19 throughout the period.

## 20 **Through-Delta**

21 The effects of Alternative 2A on through-Delta migration were evaluated using the approach  
22 described in Alternative 1A, Impact AQUA-42.

### 23 **Juveniles**

24 Flows under Alternative 2A would generally decrease up to 25% depending on month downstream  
25 of the north Delta facilities compared to baseline conditions (NAA). The intake structures would  
26 replace aquatic habitat and likely attract piscivorous fish around the intake structures. As described  
27 for Alternative 1A, the five NDD intakes would remove or modify habitat along that portion of the  
28 migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation  
29 losses at the north Delta intakes, as estimated by the bioenergetics model with median density of  
30 predators (119 striped bass per 1,000 feet of intake), would be less than 2% compared to the annual  
31 production estimated for the Sacramento Valley (Table 11-1A-17). A conservative assumption of 5%  
32 loss per intake would yield a cumulative loss of 19.2% of juvenile spring-run Chinook that reach the  
33 north Delta. This assumption is uncertain and represents an upper bound estimate.

34 Through-Delta survival to Chipps Island (DPM) by emigrating juvenile spring-run Chinook salmon  
35 under Alternative 2A would average 29% across all years, 24% in drier years, and 38% in wetter  
36 years (Table 11-2A-31). Compared to NAA, juvenile survival would decrease slightly, 1.4% lower  
37 across all years (a 5% relative decrease) and 2.7% lower (7% relative decrease) in wetter years.

1 **Table 11-2A-31. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**  
2 **under Alternative 2A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A2A_LLT	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wetter Years	42.1	40.4	37.8	-4.4 (-10%)	-2.7 (-7%)
Drier Years	24.8	24.3	23.7	-1.1 (-4%)	-0.6 (-3%)
All Years	31.3	30.3	29.0	-2.3 (-7%)	-1.4 (-5%)

Note: Delta Passage Model results for survival to Chipps Island.  
Wetter = Wet and above normal water years (6 years).  
Drier = Below normal, dry and critical water years (10 years).

3

4 **Adults**

5 When climate change effects are accounted for (NAA), during the overall spring-run upstream  
6 migration from March-June the proportion of Sacramento River water would decrease 6% to 10%  
7 compared to NAA (Table 11-2A-17). Although Sacramento River attraction flows would be reduced  
8 during these months relative to Existing Conditions, the Sacramento River would still represent 59%  
9 to 67% of Delta flows. For a discussion of the topic see the analysis for Alternative 1A. Overall the  
10 impact on adult winter-run salmon upstream migration would be less than significant. No mitigation  
11 would be required.

12 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 2A is adverse due to the  
13 cumulative effects associated with five north Delta intake facilities, including mortality related to  
14 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to  
15 reduced flows downstream of the intakes) associated with the five NDD intakes.

16 Upstream of the Delta migration conditions for spring-run Chinook salmon under Alternative 2A  
17 would not be adverse because flow and temperature conditions would generally be similar to those  
18 under the NEPA baseline.

19 Adult attraction flows under Alternative 2A would be lower than those under NAA, but adult  
20 attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

21 Near-field effects of Alternative 2A NDD on spring-run Chinook salmon related to impingement and  
22 predation associated with five new intakes could result in substantial effects on juvenile migrating  
23 spring-run Chinook salmon, although there is high uncertainty regarding the potential effects.  
24 Estimates within the effects analysis range from very low levels of effects (<1% mortality) to very  
25 significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented  
26 with the intent of providing localized and temporary reductions in predation pressure at the NDD.  
27 Additionally, several pre-construction surveys to better understand how to minimize losses  
28 associated with the five new intake structures will be implemented as part of the final NDD screen  
29 design effort. Alternative 2A also includes an Adaptive Management Program and Real-Time  
30 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
31 adequate migration conditions for spring-run Chinook salmon. However, at this time, due to the  
32 absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of  
33 mortality expected from near-field effects at the NDD remains highly uncertain.

1 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
2 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
3 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 2A  
4 predict improvements in smolt condition and survival associated with increased access to the Yolo  
5 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
6 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
7 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

8 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
9 all of these elements of BDCP operations and conservation measures to predict smolt migration  
10 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
11 migration survival under Alternative 2A would be similar to survival rates estimated for NAA.  
12 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
13 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
14 future. These efforts are expected to improve our understanding of the relationships and  
15 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
16 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
17 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
18 2A on spring-run Chinook salmon through-Delta survival remains uncertain.

19 Therefore, primarily as a result of reduced upstream migration habitat conditions for spring-run  
20 Chinook salmon due to unacceptable levels of uncertainty regarding the cumulative impacts of near-  
21 field and far-field effects associated with the presence and operation of the five intakes on spring-  
22 run Chinook salmon, this effect is adverse. While implementation of the conservation and mitigation  
23 measures listed below would address these impacts, these are not anticipated to reduce the impacts  
24 to a level considered not adverse.

### 25 ***CEQA Conclusion:***

#### 26 **Upstream of the Delta**

27 In general, Alternative 2A would affect migration conditions for spring-run Chinook salmon relative  
28 to the Existing Conditions.

#### 29 ***Sacramento River***

30 Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-  
31 run Chinook salmon migration period under A2A\_LLT would generally be similar to or greater than  
32 flows under Existing Conditions except during December in wet water years (8% decrease), during  
33 March in below normal water years (10% decrease), and during May in wet water years (15%  
34 decrease) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
36 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,  
37 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
38 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
39 Existing Conditions and Alternative 2A in any month or water year type throughout the period

40 Flows in the Sacramento River upstream of Red Bluff during the April through August adult spring-  
41 run Chinook salmon upstream migration period under A2A\_LLT would generally be similar to or  
42 greater than Existing Conditions except during May in wet years (15% decrease), July in critical

1 years (13% decrease), and August in wet (7% decrease), dry (11% decrease) and critical (24%  
2 decrease) water years.

3 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
4 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 Existing Conditions and Alternative 2A during April through June. Mean monthly water  
8 temperatures under Alternative 2A would be higher in dry and critical years during July (6% and  
9 9% higher, respectively), and up to 12% greater relative to Existing Conditions during August.

#### 10 **Clear Creek**

11 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
12 migration period under A2A\_LL2 would generally be similar to or greater than flows under Existing  
13 Conditions except in critical years during November (6% lower) (Appendix 11C, *CALSIM II Model*  
14 *Results utilized in the Fish Analysis*).

15 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
16 migration period under A2A\_LL2 would generally be similar to or greater than flows under Existing  
17 Conditions with exceptions during August of critical water years (17% lower) (Appendix 11C,  
18 *CALSIM II Model Results utilized in the Fish Analysis*).

19 Water temperatures were not modeled in Clear Creek.

#### 20 **Feather River**

21 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
22 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,  
23 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November and December under  
24 A2A\_LL2 would generally be lower than flows under Existing Conditions by up to 31%. Flows during  
25 January through May would generally be similar to or greater than flows under Existing Conditions,  
26 with few exceptions.

27 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
28 were examined during the November through May juvenile spring-run Chinook salmon migration  
29 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
30 *Results utilized in the Fish Analysis*). Water temperatures under Alternative 2A would be 5% to 6%  
31 greater than those under Existing Conditions in November and December, but similar during  
32 January through May.

33 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
34 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April through June under  
36 A2A\_LL2 would generally be similar to or greater than flows under Existing Conditions with  
37 exceptions during which flows would be up to 24% lower. Flows during July and August under  
38 A2A\_LL2 would generally be lower by up to 53% than flows under Existing Conditions.

39 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
40 were examined during the April through August adult spring-run Chinook salmon upstream  
41 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*

1 *Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 2A  
2 would be 5% to 8% higher than those under Existing Conditions during July and August, and similar  
3 during April through June.

#### 4 **Through-Delta**

5 Through Delta survival by emigrating juvenile spring-run Chinook salmon would decrease 2.3%  
6 (7% relative decrease) under Alternative 2A across all years compared to Existing Conditions (Table  
7 11-2A-31). Losses due to predation at the five north Delta intakes could hypothetically range from  
8 less than 2% up to 19.2% of juvenile spring-run Chinook that reach the north Delta, as calculated for  
9 Impact AQUA-60 for Alternative 1A.

10 Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, declined  
11 10% to 12% during the April and May migration period for spring-run adults under Alternative 2A  
12 compared to Existing Conditions (Table 11-2A-17). The reductions in percentage are small in  
13 comparison with the magnitude of change in dilution reported to cause a significant change in  
14 migration by Fretwell (1989) and, therefore, are not expected to significantly impact adult  
15 migration. Sacramento River attraction flows would still represent 59% to 67% of Delta flows.  
16 However, uncertainty remains with regard to adult salmon behavioral response to anticipated  
17 changes in lower Sacramento River flow percentages. This topic is discussed further in Impact  
18 AQUA-42 in Alternative 1A.

#### 19 **Summary of CEQA Conclusion**

20 Migration conditions throughout most of the Plan Area would generally decline for emigrating  
21 juvenile spring-run Chinook salmon. Through Delta survival would be reduced under Alternative 2A.  
22 Attraction flows would be slightly lower compared to Existing Conditions during the adult migration  
23 period. Potential predation losses would increase at the five intake structures, ranging  
24 hypothetically from 2% to 19.2% of juveniles that reach the Delta. This impact is significant.

25 Upstream of the Delta, the results indicate that the effect would be less than significant because it  
26 would not substantially reduce the suitability of migration habitat or interfere with the movement of  
27 fish. Flows in the Sacramento River and Clear Creek and water temperatures in the Sacramento and  
28 Feather Rivers would generally not be affected by Alternative 2A. Flows would be lower in 2 months  
29 of the 7-month juvenile migration period and in 2 months of the 5-month adult migration period,  
30 although there would be no other flow reductions in the Feather River.

31 With respect to the NDD intakes, implementation of CM6 and CM15 and Mitigation Measures AQUA-  
32 60a through AQUA-60c would address these impacts, but are not anticipated to reduce them to a  
33 level considered less than significant. Although implementation of *CM6 Channel Margin*  
34 *Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be  
35 located near the intakes and therefore would not fully compensate for the lost habitat. Additionally,  
36 implementation of this measure would not fully address predation losses. *CM15 Localized Reduction*  
37 *of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness  
38 such that it is considered to have no demonstrable effect. Conservation measures that address  
39 habitat and predation losses, therefore, would potentially minimize impacts to some extent but not  
40 to a less than significant level. Consequently, as a result of these changes in migration conditions,  
41 this impact is significant and unavoidable.

1 Applicable conservation measures are briefly described below and full descriptions are found in  
2 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
3 Reduction of Predatory Fishes (Predator Control) (CM15).

4 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
5 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
6 habitats on the waterside side of levees along channels that provide rearing and outmigration  
7 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
8 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
9 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
10 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
11 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
12 margin enhancement would be performed only along channels that provide rearing and  
13 outmigration habitat for juvenile salmonids. These include channels that are protected by  
14 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
15 among several others.

16 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
17 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
18 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
19 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
20 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
21 Therefore, this conservation measure is not intended to entirely remove predators at any  
22 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
23 conservation measure would also not remove piscivorous birds. Because of uncertainties  
24 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
25 projects and research actions coupled with an adaptive management and monitoring program to  
26 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
27 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
28 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

29 In addition to the conservation measures, the mitigation measures identified below would provide  
30 an adaptive management process, that may be conducted as a part of the Adaptive Management and  
31 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing  
32 impacts and developing appropriate minimization measures. However, this would not necessarily  
33 result in a less than significant determination.

34 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**  
35 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
36 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

37 Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for  
38 spring-run Chinook salmon.

39 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**  
40 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

41 Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for  
42 spring-run Chinook salmon.

1           **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**  
2           **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**  
3           **Conditions Consistent with CM1**

4           Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for  
5           spring-run Chinook salmon.

6           **Restoration and Conservation Measures**

7           Alternative 2A has the same restoration and conservation measures as Alternative 1A. Because no  
8           substantial differences in fish effects are anticipated anywhere in the affected environment under  
9           Alternative 2A compared to those described in detail for Alternative 1A, the effects described for  
10          spring-run Chinook salmon under Alternative 1A (Impact AQUA-61 through AQUA-72) also  
11          appropriately characterize effects under Alternative 2A.

12          The following impacts are those presented under Alternative 1A that are identical for Alternative  
13          2A.

14          **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**  
15          **(Spring-Run ESU)**

16          **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**  
17          **Salmon (Spring-Run ESU)**

18          **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

19          **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
20          **ESU) (CM12)**

21          **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
22          **(Spring-Run ESU) (CM13)**

23          **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
24          **Run ESU) (CM14)**

25          **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
26          **(Spring-Run ESU) (CM15)**

27          **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
28          **(CM16)**

29          **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
30          **(CM17)**

31          **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
32          **(CM18)**

33          **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
34          **ESU) (CM19)**

1 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
2 **(Spring-Run ESU) (CM21)**

3 **NEPA Effects:** These impact mechanisms have been determined to range from no effect, to no  
4 adverse effect, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the  
5 reasons identified for Alternative 1A. Specifically for AQUA-62, the effects of contaminants on  
6 spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be  
7 adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

8 **CEQA Conclusion:** These impact mechanisms would be considered to range from no impact, to less  
9 than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for  
10 Alternative 1A, and no mitigation is required.

11 **Fall-/Late Fall–Run Chinook Salmon**

12 **Construction and Maintenance of CM1**

13 The construction- and maintenance-related effects of Alternative 2A would be identical for all four  
14 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the  
15 discussion of these effects for winter-run Chinook (Impact AQUA-43 and Impact AQUA-44).

16 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
17 **(Fall-/Late Fall–Run ESU)**

18 The potential effects of construction of the water conveyance facilities on fall-/late fall–run Chinook  
19 salmon would be similar to those described for Alternative 1A (Impact AQUA-73) except that  
20 Alternative 2A could potentially include two different intakes than under Alternative 1A. This would  
21 convert about 11,350 lineal feet of existing shoreline habitat into intake facility structures and  
22 would require about 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would  
23 convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. The effects related  
24 to temporary increases in turbidity, accidental spills, underwater noise, in-water work activities,  
25 and disturbance of contaminated sediments would be similar to Alternative 1A and the same  
26 environmental commitments and mitigation measures (described under Impact AQUA-1 for delta  
27 smelt and in Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize  
28 potential effects.

29 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-73, environmental commitments and  
30 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
31 not be adverse for fall-/late fall–run Chinook salmon.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-73, the impact of construction of the  
33 water conveyance facilities on fall-/late fall–run Chinook salmon would not be significant except for  
34 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
35 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

36 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
37 **of Pile Driving and Other Construction-Related Underwater Noise**

38 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
39 Alternative 1A.

**Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise**

Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of Alternative 1A.

**Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall-Run ESU)**

The construction-related effects of Alternative 2A would be identical for all four Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the discussion of these effects for winter-run Chinook (Alternative 2A, Impact AQUA-38).

**Water Operations of CM1**

**Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late Fall-Run ESU)**

**Water Exports from SWP/CVP South Delta Facilities**

Alternative 2A (A2A\_LLT) would decrease entrainment of fall-run Chinook salmon by approximately 58% and late fall-run Chinook salmon by approximately 41% compared to NAA (Table 11-2A-32). Entrainment reductions under Alternative 2A would be greater in wetter years, ranging from a 8% decrease in dry years up to 84% decrease compared to Existing Conditions.

**Table 11-2A-32. Juvenile Chinook Salmon Annual Entrainment Index at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 2A**

Water Year Type	Absolute Difference (Percent Difference) <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
<b>Fall-Run Chinook Salmon</b>		
Wet	-107,545 (-84%)	-112,297 (-84%)
Above Normal	-22,439 (-67%)	-21,191 (-66%)
Below Normal	-5,003 (-36%)	-4,247 (-32%)
Dry	-3,371 (-16%)	-1,612 (-8%)
Critical	-7,610 (-21%)	-10,686 (-28%)
All Years	-31,474 (-57%)	-31,940 (-58%)
<b>Late Fall-Run Chinook Salmon</b>		
Wet	-3,829 (-65%)	-4,006 (-66%)
Above Normal	-307 (-55%)	-315 (-55%)
Below Normal	-22 (-41%)	-26 (-46%)
Dry	-26 (-22%)	-37 (-28%)
Critical	-37 (-25%)	-50 (-31%)
All Years	-692 (-37%)	-811 (-41%)

Shading indicates 10% or greater increased entrainment.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data.

1 For juvenile late fall-run Chinook salmon, entrainment under Alternative 2A would decrease by 41%  
2 compared to NAA averaged across all years (Table 11-2A-32). Entrainment reductions would be  
3 substantially greater in wetter years, ranging from approximately 28% decrease in dry years to 66%  
4 decrease in wet years compared to Existing Conditions.

5 The proportion of the annual juvenile population (assumed to be 23 million fall-run juveniles and 1  
6 million late fall-run juveniles) lost at the south Delta facilities is very low under baseline conditions  
7 (<0.25% for both runs), and would be reduced under Alternative 2A.

#### 8 ***Water Exports from SWP/CVP North Delta Intake Facilities***

9 Impacts from the proposed north Delta intake facilities for fall-/late fall-run Chinook salmon, such  
10 as impingement and predation exposure risks, would be expected to be similar to those described  
11 above for winter-run Chinook salmon. Impacts would also be the same as described for Alternative  
12 1A. State-of-the-art fish screens would be expected to eliminate entrainment risk for juvenile  
13 fall-/late fall-run Chinook salmon to these intakes.

#### 14 ***Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct***

15 The effects would be the same as described for Impact AQUA-39 under Alternative 1A. Entrainment  
16 and impingement effects on fall-/late fall-run Chinook salmon would be minimal for Alternative 2A  
17 because intakes would have state-of-the-art screens installed.

18 ***NEPA Effects:*** Under Alternative 2A potential entrainment of juvenile Chinook salmon of all races  
19 (winter, spring, fall and late fall-run) would be similar or reduced compared to baseline at the  
20 SWP/CVP south delta facilities and the NBA. Entrainment of Chinook salmon at the proposed  
21 SWP/CVP north Delta intakes would not be expected to occur due to the state-of-the-art fish  
22 screens; there would be a potential for impingement, but this risk would be minimized due to the  
23 design and operation of the facilities. Therefore the effect on fall-/late fall-run Chinook salmon  
24 entrainment from Alternative 2A would not be adverse.

25 ***CEQA Conclusion:*** As described above, entrainment of juvenile Chinook salmon of all races (winter,  
26 spring, fall and late fall-run) would be similar or reduced compared to baseline at the SWP/CVP  
27 south delta facilities, agricultural diversions, and the NBA. Entrainment of Chinook salmon at the  
28 proposed SWP/CVP north delta intakes would not be expected to occur due to the state-of-the-art  
29 fish screens; there would be a potential for impingement, but this risk would be minimized due to  
30 the design and operation of the facilities. Overall, impacts of water operations on entrainment of  
31 juvenile Chinook salmon (fall-/late fall-run ESU) would be beneficial due to a general reduction in  
32 entrainment and no mitigation would be required.

#### 33 ***Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for*** 34 ***Chinook Salmon (Fall-/Late Fall-Run ESU)***

35 In general, Alternative 2A would not affect spawning and egg incubation habitat for fall-/late fall-  
36 run Chinook salmon relative to NAA.

1 **Sacramento River**

2 *Fall-Run*

3 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-  
4 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
5 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be greater than or similar to flows under  
6 NAA in October, December, and January. Flows under A2A\_LLT would generally be greater than or  
7 similar to NAA during October, December, and January, except in below normal years during  
8 October. During November, flows under A2A\_LLT would be 5% to 17% lower than under NAA  
9 depending on water year type.

10 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning  
11 and egg incubation period. As reported in Impact AQUA-58 for spring-run Chinook salmon, end of  
12 September Shasta Reservoir storage would be similar to or greater than storage under NAA in all  
13 water year types (Table 11-2A-19).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
15 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
16 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
17 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
18 between NAA and Alternative 2A in any month or water year type throughout the period.

19 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
20 increments was determined for each month during October through April and year of the 82-year  
21 modeling period (Table 11-2A-10). The combination of number of days and degrees above the 56°F  
22 threshold were further assigned a “level of concern” as defined in Table 11-2A-11. Differences  
23 between baselines and Alternative 2A in the highest level of concern across all months and all 82  
24 modeled years are presented in Table 11-2A-20. There would be 1 (2%) and 4 (24%) more years  
25 with “red” and “orange” level of concern under Alternative 2A. There would be 5 (71%) fewer years  
26 with a “yellow” level of concern under Alternative 2A.

27 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
28 October through April. Total degree-days under Alternative 2A would be 6% higher than those  
29 under NAA during October, 8% higher during November, 9% higher during March, 5% lower during  
30 April, and similar during remaining months (Table 11-2A-21).

31 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
32 Sacramento River under A2A\_LLT would be lower than or similar to mortality under NAA in all  
33 water year types including below normal years (up to 10% greater relative to NAA, but absolute  
34 increase of 2% of fall-run population) (Table 11-2A-33).

**Table 11-2A-33. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	11 (110%)	1 (6%)
Above Normal	12 (109%)	1 (4%)
Below Normal	13 (126%)	2 (10%)
Dry	17 (120%)	1 (2%)
Critical	9 (31%)	-0.5 (-1%)
All	13 (90%)	1 (4%)

SacEFT predicts that there would be a 46% increase in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A2A\_LLT relative to NAA (Table 11-2A-34). SacEFT predicts that there would be a 12% reduction in the percentage of years with good (lower) redd scour risk under A2A\_LLT relative to NAA. SacEFT predicts that there would be no difference between A2A\_LLT and NAA. SacEFT predicts that there would be a 19% increase in the percentage of years with good (lower) redd dewatering risk under A2A\_LLT relative to NAA.

**Table 11-2A-34. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Spawning WUA	3 (6%)	16 (46%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-25 (-27%)	0 (0%)
Redd Dewatering Risk	5 (19%)	5 (19%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-9 (-29%)	2 (10%)

WUA = Weighted Usable Area.

*Late Fall-Run*

Sacramento River flows upstream of Red Bluff were examined for the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be greater than or similar to flows under NAA throughout the period.

Shasta Reservoir storage at the end of September would affect flows during the late fall-run spawning and egg incubation period. As reported in Impact AQUA-58 for spring-run Chinook salmon, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-2A-19).

The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the Sacramento River under A2A\_LLT would be similar to mortality under NAA in all water years, including below normal water years in which, although there would be an 11% relative increase, the absolute increase would be 1% of the late fall-run population (Table 11-2A-35).

1 **Table 11-2A-35. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook**  
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	4 (182%)	-1 (-9%)
Above Normal	4 (151%)	-1 (-13%)
Below Normal	5 (313%)	1 (11%)
Dry	4 (163%)	-0.5 (-6%)
Critical	3 (148%)	0.1 (1%)
All	4 (183%)	-0.3 (-5%)

3  
4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
5 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix  
6 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
8 between NAA and Alternative 2A in any month or water year type throughout the period.

9 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
10 increments was determined for each month during October through April and year of the 82-year  
11 modeling period (Table 11-2A-10). The combination of number of days and degrees above the 56°F  
12 threshold were further assigned a “level of concern” as defined in Table 11-2A-11. Differences  
13 between baselines and Alternative 2A in the highest level of concern across all months and all 82  
14 modeled years are presented in Table 11-2A-20. There would be 1 (2%) and 4 (24%) more years  
15 with “red” and “orange” level of concern under Alternative 2A. There would be 5 (71%) fewer years  
16 with a “yellow” level of concern under Alternative 2A. The level of concern in these years would be  
17 reduced to an “none” (from “yellow”) level.

18 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
19 October through April. Total degree-days under Alternative 2A would be 6% higher than those  
20 under NAA during October, 8% higher during November, 9% higher during March, 5% lower during  
21 April, and similar during remaining months (Table 11-2A-21).

22 SacEFT predicts that there would be a 4% decrease in the percentage of years with good spawning  
23 availability for late fall–run Chinook salmon, measured as weighted usable area, under A2A\_LLT  
24 relative to NAA (Table 11-2A-36). SacEFT predicts that there would be a negligible (<5%) difference  
25 in the percentage of years with good (lower) egg incubation conditions and redd dewatering risk  
26 between A2A\_LLT and NAA.

**Table 11-2A-36. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Spawning WUA	-6 (-12%)	-2 (-4%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-3 (-5%)	2 (4%)
Juvenile Rearing WUA	-5 (-11%)	-23 (-37%)
Juvenile Stranding Risk	-27 (-38%)	-1 (-2%)

WUA = Weighted Usable Area.

**Clear Creek**

No water temperature modeling was conducted in Clear Creek.

**Fall-Run**

Clear Creek flows below Whiskeytown Reservoir were examined for the September through February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to or greater than flows under NAA in all water year types.

The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of flow reduction each month over the incubation period compared to the flow in September when spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during September through February under A2A\_LLT would be similar to or lower magnitude than the reduction under NAA for all water year types (Table 11-2A-37).

**Table 11-2A-37. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through February Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

1     **Feather River**

2     *Fall-Run*

3     Flows in the Feather River in the low flow and high flow channels were examined for the October  
4     through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,  
5     *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A2A\_LLT  
6     would be identical to those under NAA. Flows in the high-flow channel under A2A\_LLT generally be  
7     similar to or greater than those under NAA, except in above normal years during November and  
8     December and in wet an critical years during January (7% to 12% lower).

9     The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
10    comparing the magnitude of flow reduction each month over the incubation period compared to the  
11    flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during  
12    November through January were identical between A2A\_LLT and NAA (Appendix 11C, *CALSIM II*  
13    *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 2A on  
14    redd dewatering in the Feather River low-flow channel.

15    Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
16    channel) and below Thermalito Afterbay (high-flow channel) were examined during the October  
17    through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,  
18    *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
19    *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
20    NAA and Alternative 2A in any month or water year type throughout the period at either location.

21    The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley  
22    was evaluated during October through April (Table 11-2A-38). The percent of months exceeding the  
23    threshold under Alternative 2A would similar to or up to 40% lower (absolute scale for greater than  
24    2.0 through greater than 5.0 degrees C above the threshold) than the percent under NAA.

1 **Table 11-2A-38. Differences between Baseline and Alternative 2A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LLT</b>					
October	2 (3%)	14 (16%)	25 (34%)	43 (106%)	52 (280%)
November	49 (1,333%)	31 (2,500%)	21 (NA)	11 (NA)	5 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (367%)	17 (467%)	6 (500%)	6 (NA)	2 (NA)
April	12 (18%)	17 (30%)	35 (112%)	33 (193%)	21 (189%)
<b>NAA vs. A2A_LLT</b>					
October	0 (0%)	0 (0%)	1 (1%)	-5 (-6%)	-7 (-10%)
November	-9 (-14%)	-9 (-21%)	-11 (-35%)	-7 (-40%)	-1 (-20%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-22%)	-7 (-26%)	-4 (-33%)	-1 (-17%)	-1 (-33%)
April	-7 (-8%)	-6 (-8%)	-7 (-10%)	-9 (-15%)	-6 (-16%)

NA = could not be calculated because the denominator was 0.

4

5 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during  
 6 October through April (Table 11-2A-39). Total degree-months would be similar between NAA and  
 7 Alternative 2A for all months except December, in which degree-months 50% lower under  
 8 Alternative 2A and February in which degree-months would be 33% higher.

1  
2  
3

**Table 11-2A-39. Differences between Baseline and Alternative 2A Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LL	NAA vs. A2A_LL
October	Wet	99 (136%)	-3 (-2%)
	Above Normal	33 (75%)	-3 (-4%)
	Below Normal	49 (89%)	0 (0%)
	Dry	73 (138%)	2 (2%)
	Critical	41 (100%)	-3 (-4%)
	All	295 (111%)	-7 (-1%)
November	Wet	37 (NA)	0 (0%)
	Above Normal	19 (950%)	0 (0%)
	Below Normal	19 (1,900%)	-2 (-9%)
	Dry	26 (NA)	-5 (-16%)
	Critical	19 (1,900%)	1 (5%)
	All	120 (3,000%)	-6 (-5%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	-1 (-50%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	-1 (-50%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	1 (100%)
	Dry	1 (NA)	1 (NA)
	Critical	2 (NA)	0 (0%)
	All	4 (NA)	1 (33%)
March	Wet	5 (NA)	0 (0%)
	Above Normal	2 (200%)	0 (0%)
	Below Normal	19 (1,900%)	-2 (-9%)
	Dry	23 (575%)	0 (0%)
	Critical	18 (450%)	1 (5%)
	All	67 (670%)	-1 (-1%)
April	Wet	37 (264%)	-1 (-2%)
	Above Normal	26 (113%)	-1 (-2%)
	Below Normal	22 (55%)	-3 (-5%)
	Dry	38 (78%)	-3 (-3%)
	Critical	31 (107%)	0 (0%)
	All	153 (99%)	-9 (-3%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
2 Feather River under A2A\_LLT would be similar to or lower than mortality under NAA in all water  
3 years, including critical water years in which, although there would be a 10% relative increase, the  
4 absolute increase would be 3% of the late fall-run population (Table 11-2A-40).

5 **Table 11-2A-40. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**  
6 **Salmon Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	17 (1,253%)	-2 (-8%)
Above Normal	14 (1,210%)	1 (10%)
Below Normal	14 (768%)	1 (4%)
Dry	19 (843%)	-0.2 (-1%)
Critical	20 (418%)	-3 (-10%)
All	17 (800%)	-1 (-4%)

7

8 ***American River***

9 ***Fall-Run***

10 Flows in the American River at the confluence with the Sacramento River were examined during the  
11 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be similar to or  
13 greater than flows under NAA, except for wet and above normal water years during October (7%  
14 and 10% lower, respectively) and critical water years during November (9% lower).

15 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
16 during the October through January fall-run Chinook salmon spawning and egg incubation period  
17 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
18 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
19 temperature between NAA and Alternative 2A in any month or water year type throughout the  
20 period.

21 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
22 Avenue Bridge was evaluated during November through April (Table 11-2A-41). The percent of  
23 months exceeding the threshold under Alternative 2A would similar to or up to 11% lower (absolute  
24 scale) than the percent under NAA.

1 **Table 11-2A-41. Differences between Baseline and Alternative 2A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**  
 3 **River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LLT</b>					
November	43 (95%)	48 (177%)	52 (382%)	43 (1,750%)	32 (2,600%)
December	1 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (220%)	16 (217%)	11 (450%)	10 (800%)	5 (NA)
April	25 (35%)	25 (40%)	27 (59%)	31 (96%)	25 (91%)
<b>NAA vs. A2A_LLT</b>					
November	-4 (-4%)	-10 (-12%)	-9 (-12%)	-11 (-20%)	-7 (-18%)
December	0 (0%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-20%)	-9 (-27%)	-2 (-15%)	-1 (-10%)	0 (0%)
April	-1 (-1%)	-6 (-7%)	-7 (-9%)	-9 (-12%)	-5 (-9%)

NA = could not be calculated because the denominator was 0.

4  
 5 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
 6 Avenue Bridge during November through April (Table 11-2A-42). Total degree-months would be  
 7 similar between NAA and Alternative 2A for all months.

1 **Table 11-2A-42. Differences between Baseline and Alternative 2A Scenarios in Total Degree-**  
 2 **Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above**  
 3 **56°F in the American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
November	Wet	76 (304%)	-6 (-6%)
	Above Normal	33 (300%)	-3 (-6%)
	Below Normal	44 (550%)	1 (2%)
	Dry	47 (362%)	-4 (-6%)
	Critical	36 (225%)	-2 (-4%)
	All	235 (322%)	-15 (-5%)
December	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	3 (NA)	1 (50%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	4 (NA)	0 (0%)
	All	4 (NA)	0 (0%)
March	Wet	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	10 (333%)	-1 (-7%)
	Dry	25 (625%)	0 (0%)
	Critical	19 (190%)	-1 (-3%)
	All	74 (389%)	-3 (-3%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	33 (150%)	-1 (-2%)
	Below Normal	39 (108%)	-2 (-3%)
	Dry	41 (54%)	-4 (-3%)
	Critical	36 (61%)	1 (1%)
	All	207 (94%)	-6 (-1%)

NA = could not be calculated because the denominator was 0.

4

5 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
 6 comparing the magnitude of flow reduction each month over the incubation period compared to the  
 7 flow in October when spawning is assumed to occur. The greatest monthly reduction in American

1 River flows during November through January under A2A\_LLT be 60% to 65% greater in magnitude  
2 than under NAA in below normal, dry, and critical water years and 11% to 30% lower in magnitude  
3 than NAA in wet and above normal water years (Table 11-2A-43).

4 **Table 11-2A-43. Difference and Percent Difference in Greatest Monthly Reduction (Percent**  
5 **Change) in Instream Flow in the American River at Nimbus Dam during the October through**  
6 **January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-20 (-91%)	5 (11%)
Above Normal	2 (7%)	12 (30%)
Below Normal	-58 (-301%)	-30 (-65%)
Dry	-25 (-54%)	-27 (-61%)
Critical	-12 (-24%)	-24 (-60%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

7

8 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
9 American River under A2A\_LLT would be similar to mortality under NAA in all water years (Table  
10 11-2A-44).

11 **Table 11-2A-44. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**  
12 **Salmon Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	24 (159%)	0.4 (1%)
Above Normal	22 (206%)	-1 (-3%)
Below Normal	22 (175%)	-1 (-2%)
Dry	16 (99%)	0 (0%)
Critical	9 (43%)	-1 (-3%)
All	19 (128%)	-0.2 (-1%)

13

14 **Stanislaus River**

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
16 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
17 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to  
18 flows under NAA throughout the period.

19 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative  
20 2A throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*  
21 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
3 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
4 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to flows under NAA throughout  
5 the period.

6 Water temperature modeling was not conducted in the San Joaquin River.

7 **Mokelumne River**

8 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
9 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
10 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to flows under NAA throughout  
11 the period.

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **NEPA Effects:** Collectively, it is concluded that the effect is not adverse because spawning and egg  
14 incubation habitat conditions are not substantially reduced. There are no reductions in flows under  
15 Alternative 2A or increases in temperatures that would translate into adverse biological effects on  
16 fall-/late fall-run Chinook salmon spawning and egg incubation habitat. Further, the Reclamation  
17 egg mortality model predicts no effects of Alternative 2A on fall-/late fall-run Chinook salmon  
18 spawning and egg incubation habitat in the Sacramento, Feather, and American Rivers and SacEFT  
19 predicts generally negligible or beneficial impacts on spawning and egg incubation habitat in the  
20 Sacramento River.

21 **CEQA Conclusion:** In general, Alternative 2A would not affect spawning and egg incubation habitat  
22 for fall-/late fall-run Chinook salmon relative to the Existing Conditions.

23 **Sacramento River**

24 *Fall-Run*

25 Flows in the Sacramento River upstream of Red Bluff under A2A\_LLT would generally be greater  
26 than or similar to Existing Conditions during October, December, and January, except in wet years  
27 during December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During  
28 November, flows under A2\_LLT would be 3% to 13% lower than under Existing Conditions  
29 depending on water year type.

30 Storage volume at the end of September would be 7% to 12% lower under A2A\_LLT relative to  
31 Existing Conditions (Table 11-2A-19).

32 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
33 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
34 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
35 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
36 between Existing Conditions and Alternative 2A during the period, except during October, in which  
37 temperatures would be 6% higher under Alternative 2A.

38 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
39 increments was determined for each month during October through April and year of the 82-year

1 modeling period (Table 11-2A-10). The combination of number of days and degrees above the 56°F  
2 threshold were further assigned a “level of concern” as defined in Table 11-2A-11. Differences  
3 between baselines and Alternative 2A in the highest level of concern across all months and all 82  
4 modeled years are presented in Table 11-2A-20. There would be 308% and 183% increases in the  
5 number of years with “red” and “orange” levels of concern under Alternative 2A relative to Existing  
6 Conditions.

7 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
8 October through April. Total degree-days under Alternative 2A would be 9% to 3838% higher than  
9 those under Existing Conditions during October, November, March, and April, and similar during  
10 December through February (Table 11-2A-21).

11 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
12 Sacramento River under A2A\_LLT would be 31% to 126% greater than mortality under Existing  
13 Conditions, which is a 9% to 17% increase on an absolute scale (Table 11-2A-33).

14 SacEFT predicts that there would be a 6% increase in the percentage of years with good spawning  
15 availability, measured as weighted usable area, under A2A\_LLT relative to Existing Conditions  
16 (Table 11-2A-34). SacEFT predicts that there would be a 5% reduction in the percentage of years  
17 with good (lower) redd scour risk under A2A\_LLT relative to Existing Conditions. SacEFT predicts  
18 that there would be a 27% decrease in the percentage of years with good (lower) egg incubation  
19 conditions under A2A\_LLT relative to Existing Conditions. SacEFT predicts that there would be a  
20 35% decrease in the percentage of years with good (lower) redd dewatering risk under A2A\_LLT  
21 relative to Existing Conditions.

#### 22 *Late Fall–Run*

23 Flows in the Sacramento River upstream of Red Bluff were examined during the February through  
24 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*  
25 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be greater than or  
26 similar to flows under Existing Conditions, except in below normal years during March (6% lower)  
27 and wet years during May (15% lower).

28 Storage volume at the end of September would be 7% to 12% lower under A2A\_LLT relative to  
29 Existing Conditions (Table 11-2A-19).

30 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
31 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix  
32 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
33 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
34 between Existing Conditions and Alternative 2A in any month or water year type throughout the  
35 period.

36 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
37 increments was determined for each month during October through April and year of the 82-year  
38 modeling period (Table 11-2A-10). The combination of number of days and degrees above the 56°F  
39 threshold were further assigned a “level of concern” as defined in Table 11-2A-11. Differences  
40 between baselines and Alternative 2A in the highest level of concern across all months and all 82  
41 modeled years are presented in Table 11-2A-20. There would be 308% and 183% increases in the  
42 number of years with “red” and “orange” levels of concern under Alternative 2A relative to Existing  
43 Conditions.

1 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
2 October through April. Total degree-days under Alternative 2A would be 9% to 3838% higher than  
3 those under Existing Conditions during October, November, March, and April, and similar during  
4 December through February (Table 11-2A-21).

5 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the  
6 Sacramento River under A2A\_LLT would be 148% to 313% greater than mortality under Existing  
7 Conditions (Table 11-2A-35). However, absolute differences in the percent of the late-fall population  
8 subject to mortality would be minimal in all but below normal years, in which there is a 5% increase.

9 SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning  
10 availability, measured as weighted usable area, under A2A\_LLT relative to Existing Conditions  
11 (Table 11-2A-36). SacEFT predicts that there would be a 7% decrease in the percentage of years  
12 with good (lower) redd scour risk under A2A\_LLT relative to Existing Conditions. SacEFT predicts  
13 that there would be no difference in the percentage of years with good (lower) egg incubation  
14 conditions under A2A\_LLT relative to Existing Conditions. SacEFT predicts that there would be a 5%  
15 decrease in the percentage of years with good (lower) redd dewatering risk under A2A\_LLT relative  
16 to Existing Conditions.

### 17 **Clear Creek**

18 No water temperature modeling was conducted in Clear Creek.

#### 19 *Fall-Run*

20 Flows in Clear Creek below Whiskeytown Reservoir under A2A\_LLT during the September through  
21 February fall-run spawning and egg incubation period would generally be similar to or greater than  
22 flows under Existing Conditions, except in critical water years during October and November (7%  
23 and 6% lower, respectively).

24 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of  
25 flow reduction each month over the incubation period compared to the flow in September when  
26 spawning occurred. The greatest monthly reduction in Clear Creek flows during October through  
27 February under A2A\_LLT would be similar to or lower magnitude than those under Existing  
28 Conditions in wet and below normal water years, but the reduction would be 27%, 67%, and 33%  
29 greater (absolute, not relative, differences) under A2A\_LLT in above normal, dry, and critical water  
30 years, respectively (Table 11-2A-37).

### 31 **Feather River**

#### 32 *Fall-Run*

33 Flows in the low-flow channel during October through January under A2A\_LLT would be identical to  
34 those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*  
35 Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the high-flow channel  
36 under A2A\_LLT would generally be lower by up to 44% than flows under Existing Conditions.

37 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
38 comparing the magnitude of flow reduction each month over the incubation period compared to the  
39 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were  
40 identical between A2A\_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized*

1 *in the Fish Analysis*). Therefore, there would be no effect of Alternative 2A on redd dewatering in the  
2 Feather River low-flow channel.

3 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
4 Feather River under A2A\_LL1T would be 418% to 1,253% greater than mortality under Existing  
5 Conditions (Table 11-2A-40).

6 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
7 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October  
8 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,  
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
10 *Fish Analysis*). Mean monthly water temperatures would be under Alternative 2A relative to Existing  
11 Conditions by 6% to 11% higher in the low-flow channel and 5% to 9% higher in the high-flow  
12 channel depending on month.

13 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley  
14 was evaluated during October through April (Table 11-2A-38). The percent of months exceeding the  
15 threshold under Alternative 2A would similar to or up to 52% higher (absolute scale) than the  
16 percent under Existing Conditions during all months except December through February, during  
17 which there would be no difference in the percent of months exceeding the threshold.

18 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during  
19 October through April (Table 11-2A-39). Total degree-months under Alternative 2A would be 99%  
20 to 3000% higher than total degree-months under Existing Conditions, except during December  
21 through February, in which there would be no difference between Existing Conditions and  
22 Alternative 2A in total degree-months exceeding the 56°F threshold.

### 23 ***American River***

#### 24 *Fall-Run*

25 Flows in the American River at the confluence with the Sacramento River were examined during the  
26 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LL1T would generally be similar to or  
28 greater than flows under Existing Conditions during October, but generally lower by up to 33% than  
29 flows under NAA during November through January.

30 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
31 during the October through January fall-run Chinook salmon spawning and egg incubation period  
32 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
33 *utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 2A would be 5% to 13%  
34 greater than those under Existing Conditions depending on month.

35 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
36 Avenue Bridge was evaluated during November through April (Table 11-2A-41). The percent of  
37 months exceeding the threshold under Alternative 2A would be up to 52% greater (absolute scale)  
38 than the percent under Existing Conditions during November, March, and April and similar to the  
39 percent under Existing Conditions during December through February.

40 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
41 Avenue Bridge during November through April (Table 11-2A-42). Total degree-months under

1 Alternative 2A would be 94% to 322% greater than total degree-months under Existing Conditions  
2 during November, March and April and similar to total degree months under Existing Conditions  
3 during December through February.

4 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
5 comparing the magnitude of flow reduction each month over the incubation period compared to the  
6 flow in October when spawning is assumed to occur. The greatest monthly reduction in American  
7 River flows during November through January under A2A\_LLT would be up to 301% greater  
8 magnitude than those under Existing Conditions in all years except above normal (7% lower  
9 magnitude) (Table 11-2A-43).

10 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
11 American River under A2A\_LLT would be 43% to 206% greater than mortality under Existing  
12 Conditions (Table 11-2A-44).

### 13 **Stanislaus River**

14 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
15 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
16 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to Existing  
17 Conditions during October, November and December and mixed in January being similar in wet and  
18 dry years, higher in above normal years (8% higher) and lower in below normal and critical years  
19 (up to 11% lower) than those under Existing Conditions.

20 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were  
21 examined during the October through January fall-run spawning and egg incubation period  
22 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
23 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would not be  
24 different from those under Existing Conditions during October, except for wet and critical years  
25 when they would be 5% higher, and up to 7% higher during November through January.

### 26 **San Joaquin River**

27 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
28 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
29 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 8% lower than Existing  
30 Conditions during October, and generally similar to or higher than Existing Conditions during  
31 November through January.

32 Water temperature modeling was not conducted in the San Joaquin River.

### 33 **Mokelumne River**

34 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
35 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
36 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 14% lower than flows under  
37 Existing Conditions during October and November, and generally higher than Existing Conditions  
38 during December and January (up to 18% greater).

39 Water temperature modeling was not conducted in the Mokelumne River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between  
3 the CEQA baseline and Alternative 2A could be significant because, when compared to the CEQA  
4 baseline, the alternative could substantially reduce suitable spawning habitat and substantially  
5 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth  
6 above. There would be flow reductions in all waterways except Clear Creek and the San Joaquin  
7 River and increases in the exceedances of NMFS temperature thresholds in the Sacramento, Feather,  
8 and American Rivers that would substantially affect the fall-/late fall-run population. Further, the  
9 Reclamation egg mortality model predicts moderate to substantial negative impacts of Alternative  
10 2A on fall-/late fall-run Chinook salmon in the Sacramento, Feather, and American Rivers and  
11 SacEFT predicts substantially reduced spawning and egg incubation habitat conditions in the  
12 Sacramento River.

13 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
14 change, future water demands, and implementation of the alternative. The analysis described above  
15 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
16 the alternative from those of sea level rise, climate change and future water demands using the  
17 model simulation results presented in this chapter. However, the increment of change attributable  
18 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
19 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
20 implementation period, which does include future sea level rise, climate change, and water  
21 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
22 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
23 effect of the alternative from those of sea level rise, climate change, and water demands.

24 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
25 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
26 locations and during the months analyzed above would generally be similar between Existing  
27 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
28 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
29 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
30 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
31 therefore would not in itself result in a significant impact on spawning and egg incubation habitat  
32 for fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is  
33 required.

34 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
35 **(Fall-/Late Fall-Run ESU)**

36 In general, Alternative 2A would not affect the quantity and quality of larval and juvenile rearing  
37 habitat for fall-/late fall-run Chinook salmon relative to NAA.

38 ***Sacramento River***

39 ***Fall-Run***

40 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
41 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

1 *Analysis*). Flows under A2A\_LLT would be greater than or similar to flows under NAA throughout  
2 the period.

3 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and  
4 juvenile rearing period. As reported in Impact AQUA-59 for spring-run Chinook salmon, end of  
5 September Shasta Reservoir storage would be similar to or greater than storage under NAA in all  
6 water year types (Table 11-2A-19).

7 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
8 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento  
9 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
10 There would be no differences (<5%) in mean monthly water temperature between NAA and  
11 Alternative 2A in any month or water year type throughout the period.

12 SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile  
13 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A2A\_LLT  
14 relative to NAA (Table 11-2A-34). SacEFT predicts that there would be a 10% increase in the  
15 percentage of years with “good” (lower) juvenile stranding risk under A2A\_LLT relative to NAA.

16 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A2A\_LLT would be  
17 similar to mortality under NAA.

#### 18 *Late Fall-Run*

19 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run  
20 Chinook salmon juvenile rearing period of March through July (Appendix 11C, *CALSIM II Model  
21 Results utilized in the Fish Analysis*). Flows during March through June under A2A\_LLT were  
22 generally similar to or greater than those under NAA (up to 105% greater). Flows during July were  
23 up to 41% lower under A2A\_LLT than under NAA.

24 Shasta Reservoir storage at the end of September and May would affect flows during the late fall–  
25 run larval and juvenile rearing period. As reported in Impact AQUA-156, end of September Shasta  
26 Reservoir storage would be similar to or greater than storage under NAA in all water year types  
27 (Table 11-2A-19).

28 As reported in Impact AQUA-59, Shasta storage at the end of May under A2A\_LLT would be similar  
29 to or greater than storage under NAA for all water year types (Table 11-2A-9).

30 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
31 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento  
32 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
33 There would be no differences (<5%) in mean monthly water temperature between NAA and  
34 Alternative 2A in any month or water year type throughout the period.

35 SacEFT predicts that there would be a 37% decrease in the percentage of years with good juvenile  
36 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under  
37 A2A\_LLT relative to NAA (Table 11-2A-36). SacEFT predicts that there would be a 2% reduction in  
38 the percentage of years with “good” (lower) juvenile stranding risk under A2A\_LLT relative to NAA.

39 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A2A\_LLT would  
40 be similar to mortality under NAA.

1 **Clear Creek**

2 No water temperature modeling was conducted in Clear Creek.

3 *Fall-Run*

4 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
5 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Flows under A2A\_LLT would generally be similar to or greater than flows under NAA,  
7 except in critical years during February (6% reduction) and in below normal years during March  
8 (6% reduction).

9 **Feather River**

10 *Fall-Run*

11 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
12 channel) during December through June were reviewed to determine flow-related effects on larval  
13 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
14 *Analysis*). Relatively constant flows in the low flow channel throughout this period under A2A\_LLT  
15 would not differ from those under NAA. In the high flow channel, flows under A2A\_LLT would be  
16 mostly similar to or greater than flows under NAA during December through June with few  
17 exceptions during which flows would be up to 12% lower under A2A\_LLT.

18 As reported in Impact AQUA-59 for spring-run Chinook salmon, May Oroville storage volume under  
19 A2A\_LLT would be similar to storage under NAA, indicating that the difference is primarily a result  
20 of climate change (Table 11-2A-28).

21 As reported in Impact AQUA-59 for spring-run Chinook salmon, September Oroville storage volume  
22 would be similar to or up to 5% lower than under NAA depending on water year type (Table 11-2A-  
23 25).

24 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
25 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
26 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
27 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences  
28 (<5%) in mean monthly water temperature between NAA and Alternative 2A in any month or water  
29 year type throughout the period at either location.

30 **American River**

31 *Fall-Run*

32 Flows in the American River at the confluence with the Sacramento River were examined for the  
33 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
34 *Results utilized in the Fish Analysis*). Flows under A2A\_LLT generally be similar to or greater than  
35 flows under NAA except in dry and critical years (6% and 7% lower, respectively) during March.

36 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
37 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
38 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
2 NAA and Alternative 2A in any month or water year type throughout the period.

3 ***Stanislaus River***

4 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 2A are not  
5 different from those under NAA, for the January through May fall-run Chinook salmon juvenile  
6 rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA  
8 and Alternative 2A throughout the January through May fall-run rearing period (Appendix 11D,  
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
10 *Fish Analysis*).

11 ***San Joaquin River***

12 Flows in the San Joaquin River at Vernalis for Alternative 2A are not different from those under NAA,  
13 for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II*  
14 *Model Results utilized in the Fish Analysis*).

15 Water temperature modeling was not conducted in the San Joaquin River.

16 ***Mokelumne River***

17 Flows in the Mokelumne River at the Delta for Alternative 2A are not different from those under  
18 NAA, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM*  
19 *II Model Results utilized in the Fish Analysis*).

20 Water temperature modeling was not conducted in the Mokelumne River.

21 ***NEPA Effects:*** Taken together, these results indicate that the effect is not adverse because it does not  
22 have the potential to substantially reduce the amount of suitable habitat of fish. SacEFT predicts that  
23 there would be a 37% decrease in the percentage of years with good juvenile rearing availability for  
24 late fall-run, although the number of years with good juvenile stranding risk as predicted by SacEFT  
25 would not differ between Alternative 2A and the NEPA baseline, nor would late fall-run smolt  
26 equivalent habitat-related mortality as predicted by SALMOD. Despite the reduction in late fall-run  
27 rearing availability, there are no effects of Alternative 2A on fall-run or late fall-run in other  
28 waterways that would rise to the level of adverse.

29 ***CEQA Conclusion:*** In general, Alternative 2A would not affect the quantity and quality of larval and  
30 juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to the Existing Conditions.

31 ***Sacramento River***

32 ***Fall-Run***

33 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
34 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
35 *Analysis*). Flows under A2A\_LLT would generally be greater than or similar to flows under Existing  
36 Conditions, except in below normal years during March (10% lower) and wet years during May  
37 (15% lower).

1 As reported in Impact AQUA-59, end of September Shasta Reservoir storage would be 7% to 12%  
2 lower under A2A\_LLT relative to Existing Conditions depending on water year type (Table 11-2A-  
3 19).

4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
5 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
6 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
7 There would be no differences (<5%) in mean monthly water temperature between Existing  
8 Conditions and Alternative 2A in any month or water year type throughout the period.

9 SacEFT predicts that there would be an 15% increase in the percentage of years with good juvenile  
10 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A2A\_LLT  
11 relative to Existing Conditions (Table 11-2A-34). SacEFT predicts that there would be a 29%  
12 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A2A\_LLT  
13 relative to Existing Conditions.

14 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A2A\_LLT would be  
15 11% lower than mortality under Existing Conditions.

#### 16 *Late Fall–Run*

17 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run  
18 Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results*  
19 *utilized in the Fish Analysis*). Flows during March through June under A2A\_LLT were generally  
20 similar to or greater than those under Existing Conditions. Flows during July were generally lower  
21 under A2A\_LLT than under Existing Conditions.

22 As reported in Impact AQUA-59, end of September Shasta Reservoir storage would be 7% to 12%  
23 lower under A2A\_LLT relative to Existing Conditions depending on water year type (Table 11-2A-  
24 19).

25 As reported in Impact AQUA-41, end of May Shasta storage under A2A\_LLT would be similar to  
26 Existing Conditions in wet, above normal, and below normal water years, but lower by 6% to 9% in  
27 dry and critical water years (Table 11-2A-9).

28 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
29 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
30 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
31 There would be no differences (<5%) in mean monthly water temperature between Existing  
32 Conditions and Alternative 2A in any month or water year type throughout the period except for dry  
33 and critical years in July (6% and 9% higher, respectively).

34 SacEFT predicts that there would be an 11% reduction in the percentage of years with good juvenile  
35 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under  
36 A2A\_LLT relative to Existing Conditions (Table 11-2A-36). SacEFT predicts that there would be a  
37 38% reduction in the percentage of years with “good” (lower) juvenile stranding risk under  
38 A2A\_LLT relative to Existing Conditions.

39 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A2A\_LLT would  
40 be 8% higher than mortality under Existing Conditions.

1 **Clear Creek**

2 No temperature modeling was conducted in Clear Creek.

3 **Fall-Run**

4 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
5 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Flows under A2A\_LLT would be similar to or greater than flows under Existing Conditions  
7 for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 **Feather River**

9 **Fall-Run**

10 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
11 channel) during December through June were reviewed to determine flow-related effects on larval  
12 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
13 *Analysis*). Relatively constant flows in the low flow channel throughout the period under A2A\_LLT  
14 would not differ from those under Existing Conditions. In the high flow channel, flows under  
15 A2A\_LLT would be mostly lower (up to 45%) during December and February and mostly similar to  
16 or greater than flows under Existing Conditions during January and March through June with few  
17 exceptions during which flows would be up to 46% lower under A2A\_LLT.

18 As reported under in Impact AQUA-59, May Oroville storage volume under A2A\_LLT would be lower  
19 than Existing Conditions by 6% to 21% depending on water year type, except in wet years, in which  
20 storage would be similar to Existing Conditions (Table 11-2A-25).

21 As reported in Impact AQUA-59, September Oroville storage volume would be 7% to 36% lower  
22 under A2A\_LLT relative to Existing Conditions depending on water year type (Table 11-2A-28).

23 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
24 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
25 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
26 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean  
27 monthly water temperatures under Alternative 2A would be 5% to 11% higher than those under  
28 Existing Conditions during December through March, but not different from those under Existing  
29 Conditions during April through June. In the high-flow channel, mean monthly water temperatures  
30 under Alternative 2A would be 6% to 10% higher than those under Existing Conditions during  
31 December through February, but not different from those under Existing Conditions during March  
32 through June.

33 **American River**

34 **Fall-Run**

35 Flows in the American River at the confluence with the Sacramento River were examined for the  
36 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
37 *Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be similar to or greater  
38 than flows under Existing Conditions, except during January in below normal, dry and critical years  
39 (16% to 18% lower) and in critical years during February and March (14% and 10%, respectively).

1 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
2 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). Mean monthly water temperatures under Alternative 2A would be 5% to 7% higher  
5 than those under Existing Conditions during January through March and May, but not different  
6 during April.

#### 7 **Stanislaus River**

8 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
9 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
10 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally similar to those  
11 under Existing Conditions from October through December and 11% lower during January.

12 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
13 River were examined during the January through May fall-run Chinook salmon juvenile rearing  
14 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
15 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would  
16 be 6% higher than those under Existing Conditions in all months during the period.

#### 17 **San Joaquin River**

18 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
19 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
20 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 8% lower than Existing  
21 Conditions in most water years during October, similar to Existing Conditions in November through  
22 January.

23 Water temperature modeling was not conducted in the San Joaquin River.

#### 24 **Mokelumne River**

25 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
26 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
27 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 14% lower than flows under  
28 Existing Conditions during October and up to 18% greater than flows under Existing Conditions  
29 during November through January.

30 Water temperature modeling was not conducted in the Mokelumne River.

#### 31 **Summary of CEQA Conclusion**

32 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between  
33 the CEQA baseline and Alternative 2A could be significant because, when compared to the CEQA  
34 baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA  
35 conclusion set forth above. Late fall-run Chinook salmon in the Sacramento River experience small  
36 to moderate reductions in flow during August and November in most water year types relative to  
37 the Existing Conditions. SacEFT predicts that there would be a 29% reduction in years with low  
38 juvenile stranding risk, indicating that flows would be more variable during the rearing period.  
39 Flows in the Feather River for fall-run Chinook salmon would be up to 45% lower than the Existing  
40 Conditions in the majority of water years during December and February. Water temperatures

1 would be similar between Alternative 2A and Existing Conditions in the Sacramento River, although  
2 temperatures would be higher in the Feather, American, and Stanislaus Rivers under Alternative 2A.  
3 Both SacEFT and SALMOD predict reduced rearing habitat conditions under Alternative 2A relative  
4 to Existing Conditions.

5 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
6 change, future water demands, and implementation of the alternative. The analysis described above  
7 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
8 the alternative from those of sea level rise, climate change and future water demands using the  
9 model simulation results presented in this chapter. However, the increment of change attributable  
10 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
11 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
12 implementation period, which does include future sea level rise, climate change, and water  
13 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
14 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
15 effect of the alternative from those of sea level rise, climate change, and water demands.

16 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
17 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
18 locations and during the months analyzed above would generally be similar between Existing  
19 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
20 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
21 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
22 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
23 therefore would not in itself result in a significant impact on rearing habitat for fall-run Chinook  
24 salmon. This impact is found to be less than significant and no mitigation is required.

## 25 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon** 26 **(Fall-/Late Fall-Run ESU)**

### 27 **Upstream of the Delta**

28 In general, Alternative 2A would reduce migration conditions for fall-/late fall-run Chinook salmon  
29 relative to NAA.

### 30 ***Sacramento River***

#### 31 *Fall-Run*

32 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February  
33 through May under A2A\_LLTP would be similar to or greater than flows under NAA throughout the  
34 February through May juvenile fall-run migration period in all water year types (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
37 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
38 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
39 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
40 NAA and Alternative 2A in any month or water year type throughout the period.

1 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon  
2 upstream migration period (September through October) under A2A\_LLT would generally be  
3 similar to or greater than those under NAA except during above normal years during September  
4 (5% lower) and below normal years during September and October (15% and 6% lower,  
5 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
7 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
8 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in  
9 the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
10 between NAA and Alternative 2A in any month or water year type throughout the period.

#### 11 *Late Fall-Run*

12 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January  
13 through March) under A2A\_LLT would generally be similar to or greater than flows under NAA  
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
16 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
17 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the  
18 Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
19 NAA and Alternative 2A in any month or water year type throughout the period.

20 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon  
21 upstream migration period (December through February) under A2A\_LLT would be similar to or  
22 greater than those under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results  
23 utilized in the Fish Analysis*).

24 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
25 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,  
26 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the  
27 Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
28 NAA and Alternative 2A in any month or water year type throughout the period.

#### 29 **Clear Creek**

30 Water temperature modeling was not conducted in Clear Creek.

#### 31 *Fall-Run*

32 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run  
33 migrants during February through May. Flows under A2A\_LLT would be similar to or greater than  
34 flows under NAA, except in critical years during February and below normal years during March  
35 (6% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
37 upstream migration period (September through October) under A2A\_LLT would be similar to or  
38 greater than those under NAA throughout the period (Appendix 11C, *CALSIM II Model Results  
39 utilized in the Fish Analysis*).

1       **Feather River**

2       *Fall-Run*

3       Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile  
4       migration period (February through May) under A2A\_LLT would generally be similar to or greater  
5       than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6       Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
7       were examined during the February through May juvenile fall-run Chinook salmon migration period  
8       (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
9       *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
10       temperature between NAA and Alternative 2A in any month or water year type throughout the  
11       period.

12       Flows in the Feather River at the confluence with the Sacramento River during the September  
13       through October fall-run Chinook salmon adult migration period under A2A\_LLT would generally be  
14       lower by up to 33% lower than flows under NAA in September but similar to or greater than flows  
15       under NAA in October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16       Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17       were examined during the September through October fall-run Chinook salmon adult upstream  
18       migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
19       *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
20       mean monthly water temperature between NAA and Alternative 2A in any month or water year type  
21       throughout the period.

22       **American River**

23       *Fall-Run*

24       Flows in the American River at the confluence with the Sacramento River were examined during the  
25       February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*  
26       *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be generally similar to or  
27       greater than flows under NAA, except for dry and critical years during March (6% and 7% lower,  
28       respectively).

29       Mean monthly water temperatures in the American River at the confluence with the Sacramento  
30       River were examined during the February through May juvenile fall-run Chinook salmon migration  
31       period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
32       *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
33       temperature between NAA and Alternative 2A in any month or water year type throughout the  
34       period.

35       Flows in the American River at the confluence with the Sacramento River were examined during the  
36       September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
37       *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 2A during September  
38       would be 10% to 19% lower than those under NAA in wet, above normal, and below normal years  
39       and flows during October would be 7% to 10% lower in wet and above normal years. Flows in other  
40       water years would be similar to or greater than those under NAA.

1 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
2 River were examined during the September and October adult fall-run Chinook salmon upstream  
3 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
4 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
5 mean monthly water temperature between NAA and Alternative 2A in any month or water year type  
6 throughout the period.

#### 7 **Stanislaus River**

8 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
9 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
10 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 2A would be similar to  
11 those under NAA throughout the year. Mean monthly water temperatures in the Stanislaus River at  
12 the confluence with the San Joaquin River were examined during the September and October adult  
13 fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality*  
14 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
15 differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in any  
16 month or water year type throughout the period.

#### 17 **San Joaquin River**

18 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
19 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
20 *in the Fish Analysis*). Flows under Alternative 2A would be similar to those under NAA throughout  
21 the year.

22 Water temperature modeling was not conducted in the San Joaquin River.

#### 23 **Mokelumne River**

24 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
25 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
26 *in the Fish Analysis*). Flows under Alternative 2A would be similar to those under NAA throughout  
27 the year.

28 Water temperature modeling was not conducted in the Mokelumne River.

#### 29 **Through-Delta**

##### 30 **Sacramento River**

31 The effects of Alternative 2A on through-Delta migration were evaluated using the approach  
32 described in Alternative 1A, Impact AQUA-42.

##### 33 *Fall-Run*

##### 34 *Juveniles*

35 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows  
36 below the north Delta intakes compared to Existing Conditions. The predation effects of Alternative  
37 2A would be the same as those described for Alternative 1A, since there are five intakes for both  
38 alternatives. Estimates of potential predation losses ranged from 1.8% (bioenergetics model, Table

1 11-1A-17) up to 20.3% (conservative assumption of 5% loss per intake) of fall-run annual  
2 production.

3 Through-Delta survival by juvenile fall-run Chinook salmon under Alternative 2A averaged across  
4 years would be 24.3% from the Sacramento River and 16.4% from the Mokelumne River, which is  
5 not much different from NAA (Table 11-2A-45). In wetter years, mean survival would be 2.5% lower  
6 from the Sacramento (8% relative decrease) and 1.5% greater (9% relative increase) from the  
7 Mokelumne.

8 Overall, Alternative 2A would have a negative effect on fall-run Chinook salmon juvenile survival  
9 due to habitat and predation losses at the NDD intakes.

10 **Table 11-2A-45. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**  
11 **Alternative 2A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A2A	EXISTING CONDITIONS vs. A2A	NAA vs. A2A
<b>Sacramento River</b>					
Wetter Years	34.5	31.1	28.6	-5.9 (-17%)	-2.5 (-8%)
Drier Years	20.6	20.8	21.7	1.1 (5%)	0.9 (4%)
All Years	25.8	24.7	24.3	-1.5 (-6%)	-0.3 (-1%)
<b>Mokelumne River</b>					
Wetter Years	17.2	15.7	17.2	0.0 (0%)	1.5 (9%)
Drier Years	15.6	15.9	15.9	0.3 (2%)	-0.1 (<-1%)
All Years	16.2	15.9	16.4	0.2 (1%)	0.5 (3%)
<b>San Joaquin River</b>					
Wetter Years	19.3	20.3	16.6	-2.7 (-14%)	-3.6 (-18%)
Drier Years	10.0	9.5	10.9	1.0 (10%)	1.4 (14%)
All Years	13.5	13.6	13.1	-0.4 (-3%)	-0.5 (-4%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

12

13 *Adults*

14 Attraction flow for fall-run adults, as estimated by the percentage of Sacramento River water at  
15 Collinsville, increased 13% in September and decreased 1% to 4% October to December under  
16 Alternative 2A compared to NAA (Table 11-2A-17). The Sacramento River would still represent a  
17 substantial proportion (62% to 78%) of Delta outflows. The reductions in percentage are small in  
18 comparison with the magnitude of change in dilution (20% or more) reported to cause a significant  
19 change in migration by Fretwell (1989) and, therefore, are not expected to affect adult Chinook  
20 salmon migration. However, uncertainty remains with regard to adult salmon behavioral response  
21 to anticipated changes in lower Sacramento River flow percentages. This topic is discussed further  
22 in Impact AQUA-42 in Alternative 1A.

1 *Late Fall–Run*

2 *Juveniles*

3 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows  
4 below the north Delta intakes compared to Existing Conditions. Through-Delta survival by  
5 emigrating juvenile late fall–run Chinook salmon under Alternative 2A (A2A\_LLТ) would average  
6 23% across all years, ranging from 20% in drier years to 27% in wet years. Juvenile survival would  
7 decrease slightly in wetter (0.6% less survival, or 2% less in relative percentage) and similar in drier  
8 years (0.3% greater survival, or 1% more in relative percentage) compared to NAA (Table 11-2A-  
9 46). Overall, Alternative 2A would not have an adverse effect on late fall–run Chinook salmon  
10 juvenile survival due an increase in survival during all water year types.

11 **Table 11-2A-46. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon**  
12 **under Alternative 2A**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A2A_LLТ	EXISTING CONDITIONS vs. A2A_LLТ	NAA vs. A2A_LLТ
Wetter Years	28.8	27.3	26.7	-2.1 (-7%)	-0.6 (-2%)
Drier Years	18.8	20.2	20.5	1.7 (9%)	0.3 (1%)
All Years	22.5	22.9	22.8	0.3 (1%)	-0.1 (<-1%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

13

14 *Adults*

15 The adult late fall–run migration is from November through March, peaking in January through  
16 March. The proportion of Sacramento River water in the Delta would be similar (<10% difference)  
17 to NAA throughout the adult late fall–run migration (Table 11-2A-17). Alternative 2A would not  
18 have an adverse effect on late fall–run adult migration. However, uncertainty remains with regard to  
19 adult salmon behavioral response to anticipated changes in lower Sacramento River flow  
20 percentages. This topic is discussed further in Impact AQUA-42 in Alternative 1A.

21 ***San Joaquin River***

22 *Fall-Run*

23 *Juveniles*

24 The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of  
25 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.  
26 There are no flow changes associated with the alternatives. Through-Delta survival by emigrating  
27 juvenile fall–run Chinook salmon under Alternative 2A (A2A\_LLТ) would average 13% across all  
28 years (Table 11-2A-46). Juveniles from the San Joaquin River would experience 3.6% lower survival  
29 in wetter years (18% less in relative percentage) and 1.4% greater survival in drier years (14%  
30 more in relative percentage). Across all years, survival would be similar under Alternative 2A

relative to the baseline (0.5% less, or 4% relative decrease ). Overall, Alternative 2A would not have an adverse effect on fall-run Chinook salmon juvenile survival due to minor differences in survival.

*Adults*

Alternative 2A would slightly increase the proportion of San Joaquin River water in the Delta in September through December by 1.1 to 4.4% compared to NAA). The proportion of San Joaquin River water would be similar (<5% change) to NAA (Table 11-2A-47). Therefore migration conditions under Alternative 2A would be similar to those described for Alternative 1A. The effect of Alternative 2A would not be adverse on the fall-run adult migration.

**Table 11-2A-47. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 2A**

Month	Percentage of Water			Difference	
	EXISTING CONDITIONS	NAA	A2A_LLТ	EXISTING CONDITIONS vs. A2A_LLТ	NAA vs. A2A_LLТ
<b>Sacramento River</b>					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	59	-10	-6
<b>San Joaquin River</b>					
September	0.3	0.1	1.3	1.0	1.2
October	0.2	0.3	3.6	3.4	3.3
November	0.4	1.0	5.4	5.0	4.4
December	0.9	1.0	3.0	2.1	2.0
January	1.6	1.7	3.2	1.6	1.5
February	1.4	1.5	3.8	2.4	2.3
March	2.6	2.8	6.1	3.5	3.3
April	6.3	6.6	10.6	4.3	4.0

Shading indicates a difference of 10% or greater in flow proportion.

**NEPA Effects:**

Overall, the results indicate that the effect of Alternative 2A is adverse because it has the potential to substantially decrease fall- and late fall-run Chinook salmon migration habitat conditions upstream of the Delta. In addition, this alternative is adverse due to the cumulative effects associated with five north Delta intake facilities, including mortality related to near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to reduced flows downstream of the intakes) associated with the five NDD intakes.

1 Upstream of the Delta, flows in the Feather and American rivers would be up to 33% lower during at  
2 least one of the two months of the fall-run Chinook salmon adult migration period. These reductions  
3 in flow may impact the ability of adult fall-run Chinook salmon to migrate upstream successfully.  
4 There would be no other effects of Alternative 2A on upstream flows or water temperatures during  
5 the juvenile or adult migration periods for fall- and late fall-run Chinook salmon.

6 Adult attraction flows under Alternative 2A would be lower than those under NAA, but adult  
7 attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

8 Near-field effects of Alternative 2A NDD on fall- and late fall-run Chinook salmon related to  
9 impingement and predation associated with five new intakes could result in substantial effects on  
10 juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty  
11 regarding the potential effects. Estimates within the effects analysis range from very low levels of  
12 effects (<2% mortality) to very significant effects (~ 20% mortality above current baseline levels).  
13 CM15 would be implemented with the intent of providing localized and temporary reductions in  
14 predation pressure at the NDD. Additionally, several pre-construction surveys to better understand  
15 how to minimize losses associated with the five new intake structures will be implemented as part  
16 of the final NDD screen design effort. Alternative 2A also includes an Adaptive Management Program  
17 and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments  
18 intended to provide adequate migration conditions for fall- and late fall-run Chinook salmon.  
19 However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento  
20 River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly  
21 uncertain.

22 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
23 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
24 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 2A  
25 predict improvements in smolt condition and survival associated with increased access to the Yolo  
26 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
27 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
28 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

29 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
30 all of these elements of BDCP operations and conservation measures to predict smolt migration  
31 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
32 migration survival under Alternative 2A would be similar to survival rates estimated for NAA.  
33 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
34 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
35 future. These efforts are expected to improve our understanding of the relationships and  
36 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
37 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
38 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
39 2A on fall- and late fall-run Chinook salmon through-Delta survival remains uncertain.

40 Therefore, due to unacceptable levels of uncertainty regarding the cumulative impacts of near-field  
41 and far-field effects associated with the presence and operation of the five intakes on fall- and late  
42 fall-run Chinook salmon, this effect is adverse.

1 While the implementation of the conservation and mitigation measures described below would  
2 reduce the effects on migration conditions, these reductions would not necessarily result in a not  
3 adverse determination. Therefore, the overall effect is adverse.

4 **CEQA Conclusion:**

5 **Upstream of the Delta**

6 In general, Alternative 2A would affect migration conditions for fall-/late fall-run Chinook salmon  
7 relative to the Existing Conditions.

8 **Sacramento River**

9 *Fall-Run*

10 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February  
11 through May under A2A\_LLT would generally be similar to or greater than those under Existing  
12 Conditions, except in below normal water years during March (10% lower) and in wet water years  
13 during May (15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
15 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
18 Existing Conditions and Alternative 2A in any month or water year type throughout the period.

19 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon  
20 upstream migration period (September through October) under A2A\_LLT would generally be  
21 similar to or greater than those under Existing Conditions except for below normal and dry years  
22 during September (13% and 16% lower, respectively) (Appendix 11C, *CALSIM II Model Results*  
23 *utilized in the Fish Analysis*).

24 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
25 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
26 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
27 *the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would be 9% and 6%  
28 greater than those under Existing Conditions during September and October, respectively.

29 *Late Fall-Run*

30 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January  
31 through March) under A2A\_LLT would generally be similar to or greater than flows under Existing  
32 Conditions, except in below normal water years during March (10% reduction) (Appendix 11C,  
33 *CALSIM II Model Results utilized in the Fish Analysis*).

34 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
35 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
36 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
37 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
38 Existing Conditions and Alternative 2A in any month or water year type throughout the period.

1 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon  
2 upstream migration period (December through February) under A2A\_LLT would generally be  
3 similar to or greater than those under Existing Conditions, except in wet years during December  
4 (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
6 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,  
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
8 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
9 Existing Conditions and Alternative 2A in any month or water year type throughout the period.

### 10 **Clear Creek**

11 Water temperature modeling was not conducted in Clear Creek.

#### 12 *Fall-Run*

13 Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon  
14 upstream migration period (February through May) under A2A\_LLT would be similar to or greater  
15 than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*  
16 *utilized in the Fish Analysis*).

17 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
18 upstream migration period (September through October) under A2A\_LLT would generally be  
19 similar to or greater than those under Existing Conditions except in critical years (29% and 7%  
20 lower during September and October, respectively) (Appendix 11C, *CALSIM II Model Results utilized*  
21 *in the Fish Analysis*).

### 22 **Feather River**

#### 23 *Fall-Run*

24 Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile  
25 migration period (February through May) under A2A\_LLT would generally be similar to or greater  
26 than flows under Existing Conditions, except in below normal years during February and March  
27 (11% and 18% lower, respectively) and in wet years during May (24% lower) (Appendix 11C,  
28 *CALSIM II Model Results utilized in the Fish Analysis*).

29 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
30 were examined during the February through May juvenile fall-run Chinook salmon migration period  
31 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
32 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
33 temperature between Existing Conditions and Alternative 2A in any month or water year type  
34 throughout the period.

35 Flows in the Feather River at the confluence with the Sacramento River during the September  
36 through October fall-run Chinook salmon adult migration period under A2A\_LLT would generally be  
37 greater than flows under Existing Conditions, except in below normal and dry years during  
38 September (24% and 28% lower, respectively) and in wet and below normal water years during  
39 October (8% and 12% lower, respectively).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
2 were examined during the September through October fall-run Chinook salmon adult upstream  
3 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
4 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature  
5 differences (>5%) would be higher in below normal, dry and critical years during September (6%,  
6 6% and 5% higher, respectively) and in wet and dry years during October (5% higher in both years).

### 7 **American River**

#### 8 **Fall-Run**

9 Flows in the American River at the confluence with the Sacramento River were examined during the  
10 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*  
11 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT during February and March would  
12 generally be similar to or greater than flows under Existing Conditions, except for critical years  
13 (14% and 10% lower in February and March, respectively). Flows under A2A\_LLT during May would  
14 be mostly lower by up to 26% than flows under Existing Conditions.

15 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
16 River were examined during the February through May juvenile fall-run Chinook salmon migration  
17 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
18 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would  
19 be 5% to 7% higher than under Existing Conditions although April would equal or exceed 5% only in  
20 wet and above normal years.

21 Flows in the American River at the confluence with the Sacramento River were examined during the  
22 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
23 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT during September would  
24 be 28% to 56% lower than flows under Existing Conditions. Flows under A2A\_LLT during October  
25 would generally be similar to or greater than those under Existing Conditions in except in wet and  
26 above normal water years (16% and 6% lower, respectively).

27 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
28 River were examined during the September and October adult fall-run Chinook salmon upstream  
29 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
30 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
31 Alternative 2A would be 6% and 12% higher than those under Existing Conditions during  
32 September and October, respectively.

### 33 **Stanislaus River**

34 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
35 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
36 *Model Results utilized in the Fish Analysis*). Flows under Alternative 2A would be 8% to 13% lower  
37 than those under Existing Conditions throughout the period.

38 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
39 River were examined during the February through May juvenile fall-run Chinook salmon migration  
40 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
41 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would  
42 be 6% higher than those under Existing Conditions in every month of the period.

1 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
2 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 2A would be 10% and  
4 7% lower during September and October, respectively, than those under Existing Conditions

5 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
6 River were examined during the September and October adult fall-run Chinook salmon upstream  
7 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
8 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
9 Alternative 2A would be 6% higher than those under Existing Conditions during September and 5%  
10 higher in critical years during October but there would be no difference in mean monthly water  
11 temperatures between Alternative 2A and Existing Conditions in the other water years during  
12 October.

### 13 **San Joaquin River**

14 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
15 fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
16 *Analysis*). Flows under Alternative 2A would generally be similar to those under Existing Conditions  
17 during February, but up to 15% lower during the remainder of the period, particularly in drier  
18 water years.

19 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
20 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
21 *in the Fish Analysis*). Flows under Alternative 2A would be 5% and 8% lower than those under  
22 Existing Conditions during September and October, respectively.

23 Water temperature modeling was not conducted in the San Joaquin River.

### 24 **Mokelumne River**

25 Flows in the Mokelumne River at the Delta were examined during the February through May  
26 juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
27 *the Fish Analysis*). Flows under Alternative 2A would be similar to or greater than those under  
28 Existing Conditions during February and March and 8% and 12% lower than those under Existing  
29 Conditions during April and May, respectively.

30 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
31 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
32 *in the Fish Analysis*). Flows under Alternative 2A would be similar to those under Existing Conditions  
33 during both months.

34 Water temperature modeling was not conducted in the Mokelumne River.

### 35 **Through-Delta**

36 Through-Delta survival as modeled by DPM was similar or slightly reduced for Alternative 2A  
37 compared to Existing Conditions, and therefore the impact would be less than significant. Based on  
38 the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to  
39 Existing Conditions for nearly all months of the year. The proportion of flows would decrease  
40 slightly in March and April by 11 to 12%. The 11% decrease in March would affect the last month of

1 the late fall-run adult migration. An increase in the proportion of Sacramento River flows in  
 2 September by 18% though would benefit the pre-peak fall-run adult upstream migration. Through  
 3 the Delta, Sacramento River flows below the NDD would be reduced compared to baseline  
 4 conditions during adult and juvenile migration periods. Modeled juvenile survival is expected to be  
 5 similar or slightly lower in all water year types (6% relative decrease across all years). Estimated  
 6 predation losses of juveniles migrating past the five intakes could hypothetically range from 2% to  
 7 20% of annual production, although the latter estimate is a conservative upper bound. The adaptive  
 8 management program would provide a mechanism for making adjustments to minimize this effect  
 9 to some extent. In addition, *CM15 Localized Reduction of Predatory Fishes* could be implemented to  
 10 reduce potential effects. However, the benefits of these actions are uncertain. As a result of changes  
 11 in predation and habitat associated with five NDD structures, this impact is substantial.

## 12 **Summary of CEQA Conclusion**

13 There would be substantial reductions in flows and increases in temperatures in multiple upstream  
 14 waterways under Alternative 2A relative to Existing Conditions that would slow or inhibit migration  
 15 of juveniles and adult fall-/late fall-run Chinook salmon or increase thermal stress on migrants. In  
 16 addition, Alternative 2A has the potential to substantially increase predation and remove important  
 17 instream habitat in the Delta as the result of the presence of five NDD structures. Through-Delta  
 18 survival of emigrating juveniles is expected to be substantially reduced, compared to Existing  
 19 Conditions. Implementation of CM6 and CM15 and Mitigation Measures AQUA-78a through AQUA-  
 20 78c would address these impacts, but are not anticipated to reduce them to a level considered less  
 21 than significant. Although implementation of *CM6 Channel Margin Enhancement* would provide  
 22 habitat similar to that which would be lost, it would not necessarily be located near the intakes and  
 23 therefore would not fully compensate for the lost habitat. Additionally, implementation of this  
 24 measure would not fully address predation losses. *CM15 Localized Reduction of Predatory Fishes*  
 25 (*Predator Control*) has substantial uncertainties associated with its effectiveness such that it is  
 26 considered to have no demonstrable effect. Conservation measures that address habitat and  
 27 predation losses, therefore, would potentially minimize impacts to some extent but not to a less than  
 28 significant level. Consequently, as a result of these changes in migration conditions, this impact is  
 29 significant and unavoidable.

30 Applicable conservation measures are briefly described below and full descriptions are found in  
 31 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
 32 Reduction of Predatory Fishes (Predator Control) (CM15).

33 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
 34 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
 35 habitats on the waterside side of levees along channels that provide rearing and outmigration  
 36 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
 37 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
 38 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
 39 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
 40 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
 41 margin enhancement would be performed only along channels that provide rearing and  
 42 outmigration habitat for juvenile salmonids. These include channels that are protected by  
 43 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
 44 among several others.

1 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
2 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
3 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
4 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
5 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
6 Therefore, this conservation measure is not intended to entirely remove predators at any  
7 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
8 conservation measure would also not remove piscivorous birds. Because of uncertainties  
9 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
10 projects and research actions coupled with an adaptive management and monitoring program to  
11 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
12 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
13 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

14 As discussed in detail for Alternative 1A, the effects of Alternative 2A operations on through-Delta  
15 migration conditions for fall-/late fall-run Chinook salmon would be significant and unavoidable,  
16 due to predation and habitat loss associated with the five NDD intakes, and flow changes in the  
17 Feather and American Rivers. However, as with the conservation measures, the implementation of  
18 the mitigation measures listed below also has the potential to reduce the severity of the impact  
19 though not necessarily to a less-than-significant level. These mitigation measures would provide an  
20 adaptive management process, that may be conducted as a part of the Adaptive Management and  
21 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing  
22 impacts and developing appropriate minimization measures.

23 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
24 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
25 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

26 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for  
27 fall/late fall-run Chinook salmon.

28 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
29 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
30 **of CM1**

31 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for  
32 fall/late fall-run Chinook salmon.

33 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
34 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
35 **Migration Conditions Consistent with CM1**

36 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for  
37 fall/late fall-run Chinook salmon.

38 **Restoration Measures (CM2, CM4–CM7, and CM10)**

39 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
40 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
41 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of

1 restoration measures described for fall- and late fall–run Chinook salmon under Alternative 1A  
2 (Impact AQUA-79 through AQUA-81) also appropriately characterize effects under Alternative 2A.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative  
4 2A.

5 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/  
6 Late Fall–Run ESU)**

7 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook  
8 Salmon (Fall-/Late Fall–Run ESU)**

9 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-  
10 Run ESU)**

11 *NEPA Effects:* All three of these impact mechanisms have been determined to result in no adverse  
12 effects on fall- or late fall-run Chinook salmon for NEPA purposes. Specifically for AQUA-80, the  
13 effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper,  
14 ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-  
15 run Chinook salmon are uncertain.

16 *CEQA Conclusion:* All three of these impact mechanisms would be considered less than significant  
17 on fall- or late fall-run Chinook salmon, for the reasons identified for Alternative 1A, and no  
18 mitigation is required.

19 **Other Conservation Measures (CM12–CM19 and CM21)**

20 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
21 differences in other conservation-related fish effects are anticipated anywhere in the affected  
22 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish  
23 effects of other conservation measures described for fall- and late fall-run Chinook salmon under  
24 Alternative 1A (Impact AQUA-82 through AQUA-90) also appropriately characterize effects under  
25 Alternative 2A.

26 The following impacts are those presented under Alternative 1A that are identical for Alternative  
27 2A.

28 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-  
29 Run ESU) (CM12)**

30 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon  
31 (Fall-/Late Fall–Run ESU) (CM13)**

32 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-  
33 /Late Fall–Run ESU) (CM14)**

34 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon  
35 (Fall-/Late Fall–Run ESU) (CM15)**

36 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-  
37 Run ESU) (CM16)**

1 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**  
2 **ESU) (CM17)**

3 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**  
4 **ESU) (CM18)**

5 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
6 **Fall-Run ESU) (CM19)**

7 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
8 **(Fall-/Late Fall-Run ESU) (CM21)**

9 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no  
10 adverse effect, or beneficial effects on fall- or late fall-run Chinook salmon for NEPA purposes, for  
11 the reasons identified for Alternative 1A.

12 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to  
13 less than significant, or beneficial on fall- or late fall-run Chinook salmon, for the reasons identified  
14 for Alternative 1A, and no mitigation is required.

15 **Steelhead**

16 **Construction and Maintenance of CM1**

17 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

18 The potential effects of construction of the water conveyance facilities on steelhead would be similar  
19 to those described for Alternative 1A (Impact AQUA-91) except that Alternative 2A could potentially  
20 include two different intakes than under Alternative 1A. This would convert about 11,350 lineal feet  
21 of existing shoreline habitat into intake facility structures and would require about 26 acres of  
22 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
23 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
24 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
25 contaminated sediments would be similar to Alternative 1A and the same environmental  
26 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
27 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
28 effects.

29 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-91, environmental commitments and  
30 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
31 not be adverse for steelhead.

32 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-91, the impact of the construction of  
33 water conveyance facilities on steelhead would be less than significant except for construction noise  
34 associated with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation  
35 Measure AQUA-1b would reduce that noise impact to less than significant.

36 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
37 **of Pile Driving and Other Construction-Related Underwater Noise**

38 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

1 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2 **and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

4 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

5 **NEPA Effects:** The potential impacts of the maintenance of water conveyance facilities under  
6 Alternative 2A would be the same as those described for Alternative 1A (see Impact AQUA-92). As  
7 concluded in Impact AQUA-92, the effect would not be adverse for steelhead.

8 **CEQA Conclusion:** As described in Impact AQUA-92 under Alternative 1A, the impact of the  
9 maintenance of water conveyance facilities on steelhead would be less than significant and no  
10 mitigation is required.

11 **Water Operations of CM1**

12 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

13 **Water Exports from SWP/CVP South Delta Facilities**

14 Alternative 2A would reduce overall entrainment of juvenile steelhead at the south Delta export  
15 facilities by 69%, as estimated by the salvage density method (Table 11-2A-48) across all years  
16 compared to NAA. Under Alternative 2A, the greatest reductions in entrainment would be in wetter  
17 years (90% decrease). Pre-screen loss at the south Delta facilities, typically attributed to predation,  
18 would be reduced commensurate with reductions in entrainment.

19 **Table 11-2A-48. Juvenile Steelhead Annual Entrainment at the SWP and CVP Salvage Facilities—**  
20 **Differences between Model Scenarios for Alternative 2A**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A2A	NAA vs. A2A
Wet	-5,679 (-90%)	-5,761 (-90%)
Above Normal	-10,511 (-79%)	-10,279 (-78%)
Below Normal	-5,567 (-50%)	-6,301 (-53%)
Dry	-1,711 (-25%)	-2,283 (-30%)
Critical	-1,039 (-19%)	-1,625 (-27%)
All Years	-5,999 (-68%)	-6,248 (-69%)

Note: Estimated annual number of fish lost, based on non-normalized data.

21  
22 Steelhead predation loss at the south Delta facilities is assumed to be proportional to entrainment  
23 loss. Average pre-screen predation loss for steelhead entrained at the Clifton Court Forebay is about  
24 80% (Clark et al. 2009) while predation loss for fish entrained at the CVP is assumed to be 15%. By  
25 reducing entrainment at the south Delta facilities, Alternative 2A would reduce predation losses  
26 commensurate with reductions in entrainment.

27 **Water Exports from SWP/CVP North Delta Intake Facilities**

28 The potential effects of the proposed North Delta diversions would be similar to these described for  
29 Chinook salmon juveniles (see Impact AQUA-39). The north Delta intakes would be screened to

1 exclude fish larger than 15 mm, which would prevent steelhead smolts (which are larger than  
2 Chinook salmon juveniles and fry).

### 3 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

4 Entrainment and impingement effects on juvenile steelhead would be minimal for Alternative 2A  
5 because intakes would have state-of-the-art screens installed.

6 ***NEPA Effects:*** The effect under Alternative 2A would not be adverse.

7 ***CEQA Conclusion:*** As described above, entrainment and associated pre-screen predation losses of  
8 juvenile steelhead would decrease under Alternative 2A (A2A\_LLТ) compared to Existing Conditions  
9 at the south Delta export facilities (Table 11-2A-48). The north Delta screened intakes, as designed,  
10 would exclude juvenile salmonids, and decommissioning agricultural diversions would reduce  
11 potential entrainment. Impacts of water operations on entrainment of steelhead would be beneficial  
12 due to an overall reduction in entrainment and no mitigation would be required.

### 13 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 14 **Steelhead**

15 In general, the effect of Alternative 2A on steelhead spawning habitat would be negligible relative to  
16 NAA.

#### 17 ***Sacramento River***

18 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where  
19 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning  
20 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*  
21 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg  
22 incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under  
23 A2A\_LLТ throughout the period would generally be similar to those under NAA except during  
24 February during below normal water years (7% higher flow).

25 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
26 examined during the January through April primary steelhead spawning and egg incubation period  
27 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
28 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
29 temperature between NAA and Alternative 2A in any month or water year type throughout the  
30 period at either location.

31 SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning  
32 availability, measured as weighted usable area, under A2A\_LLТ relative to NAA (Table 11-2A-49).  
33 SacEFT predicts that there would be negligible (<5%) differences between NAA and A2A\_LLТ in the  
34 percentage of years with good (lower) redd scour risk and no (0%) difference in the percentage of  
35 years with good (lower) egg incubation conditions. These results indicate that there would be a low  
36 effect of Alternative 2A on spawning habitat quantity but no difference in redd scour risk or  
37 temperature-related egg incubation conditions.

1 **Table 11-2A-49. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
2 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	0 (0%)	3 (6%)
Juvenile Rearing WUA	-6 (-15%)	-10 (-22%)
Juvenile Stranding Risk	-16 (-47%)	-2 (-10%)

WUA = Weighted Usable Area.

3  
4 Overall, these results indicate that the effects of Alternative 2A on steelhead spawning and egg  
5 incubation habitat in the Sacramento River would be negligible.

6 **Clear Creek**

7 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period  
8 (January through April). Flows under A2A\_LLT would generally be similar to flows under NAA  
9 throughout the period, except in critical years during February (6% lower), below normal years  
10 during March (6% lower), and critical years during January (7% higher) (Appendix 11C, *CALSIM II*  
11 *Model Results utilized in the Fish Analysis*).

12 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest  
13 monthly flow reduction would be identical between NAA and A2A\_LLT for all water year types  
14 (Table 11-2A-50).

15 **Table 11-2A-50. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**  
16 **under Alternative 2A Model Scenarios in Clear Creek during the January–April Steelhead Spawning**  
17 **and Egg Incubation Period<sup>a</sup>**

Water Year Type	A2A_LLT vs. EXISTING CONDITIONS	A2A vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

18  
19 No water temperature modeling was conducted in Clear Creek.  
20 Overall, these results indicate that the effects of Alternative 2A on steelhead spawning and egg  
21 incubation habitat in Clear Creek would be negligible.

**Feather River**

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A2A\_LLT would not differ from NAA because minimum Feather River flows are included in the FERC settlement agreement and would be met for all model scenarios (California Department of Water Resources 2006). Flows under A2A\_LLT at Thermalito Afterbay would generally be similar to or greater than flows under NAA, except in wet and critical years during January (7% and 12% lower, respectively) and in below normal years during March (8% lower).

Oroville Reservoir storage volume at the end of September and end of May influences flows downstream of the dam during the steelhead spawning and egg incubation period. Storage volume at the end of September under A2A\_LLT would be similar to or up to 16% greater than storage under NAA depending on water year type (Table 11-2A-25). May Oroville storage under A2A\_LLT would be similar to storage under NAA (Table 11-2A-28).

Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in any month or water year type throughout the period at either location.

The percent of months exceeding the 56°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-2A-51). The percent of months exceeding the threshold under Alternative 2A would generally be similar to or lower (up to 14% lower on an absolute scale) than the percent under NAA depending on month and degrees above the threshold.

**Table 11-2A-51. Differences between Baseline and Alternative 2A Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River above Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LLT</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	5 (400%)	1 (NA)	1 (NA)	1 (NA)	1 (NA)
April	32 (371%)	14 (275%)	12 (NA)	4 (NA)	0 (NA)
<b>NAA vs. A2A_LLT</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-4 (-38%)	-1 (-50%)	0 (0%)	0 (0%)	0 (0%)
April	-12 (-23%)	-14 (-42%)	-5 (-29%)	-2 (-40%)	-1 (-100%)
NA = could not be calculated because the denominator was 0.					

1 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito  
2 Afterbay (low-flow channel) during January through April (Table 11-2A-52). Total degree-months  
3 would be similar between NAA and Alternative 2A in all months.

4 **Table 11-2A-52. Differences between Baseline and Alternative 2A Scenarios in Total**  
5 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
6 **above 56°F in the Feather River above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	3 (NA)	1 (50%)
	Critical	8 (800%)	0 (0%)
	All	13 (1,300%)	1 (8%)
April	Wet	4 (NA)	1 (33%)
	Above Normal	12 (600%)	1 (8%)
	Below Normal	16 (400%)	0 (0%)
	Dry	21 (420%)	-5 (-16%)
	Critical	21 (NA)	-2 (-9%)
	All	73 (664%)	-6 (-7%)

NA = could not be calculated because the denominator was 0.

7

8 **American River**

9 Flows in the American River at the confluence with the Sacramento River were examined for the  
10 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
11 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be similar to flows  
12 under NAA during the period except in dry and critical years during March (6% and 7% lower,  
13 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
15 during the January through April steelhead spawning and egg incubation period ((Appendix 11D,  
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
2 NAA and Alternative 2A in any month or water year type throughout the period.

3 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
4 Avenue Bridge was evaluated during November through April (Table 11-2A-41). Steelhead spawn  
5 and eggs incubate in the American River between January and April. During this period, the percent  
6 of months exceeding the threshold under Alternative 2A would be similar to or up to 20% lower  
7 (absolute scale) than the percent under NAA.

8 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
9 Avenue Bridge during November through April (Table 11-2A-42). During the January through April  
10 steelhead spawning and egg incubation period, total degree-months would be similar between NAA  
11 and Alternative 2A.

12 Overall, these results indicate that the effects of Alternative 2A on steelhead spawning and egg  
13 incubation habitat in the American River would be negligible or beneficial.

#### 14 ***San Joaquin River***

15 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 16 ***Stanislaus River***

17 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
18 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LL1T throughout this period would  
20 generally be identical to flows under NAA.

21 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative  
22 2A throughout the January through April steelhead spawning and egg incubation period (Appendix  
23 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
24 *the Fish Analysis*).

#### 25 ***Mokelumne River***

26 Flows in the Mokelumne River at the Delta were examined during the January through April  
27 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
28 *Fish Analysis*). Flows under A2A\_LL1T throughout this period would generally be identical to flows  
29 under NAA.

30 Water temperature modeling was not conducted in the Mokelumne River.

31 ***NEPA Effects:*** Collectively, these results indicate that the effect would not be adverse because it  
32 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish  
33 as a result of egg mortality. There would be no substantial effects of Alternative 2A on upstream  
34 flows or water temperatures that would affect steelhead spawning and egg incubation in any  
35 waterway evaluated. Further, SacEFT predicts no effects of Alternative 2A on steelhead spawning  
36 and egg incubation habitat.

37 ***CEQA Conclusion:*** In general, Alternative 2A would not reduce the quantity and quality of steelhead  
38 spawning habitat relative to the Existing Conditions.

1 **Sacramento River**

2 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where  
3 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning  
4 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*  
5 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg  
6 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows  
7 under A2A\_LLT would generally be similar to flows under Existing Conditions in January, March and  
8 April, and higher than flows under Existing Conditions in February with some exceptions. Upstream  
9 of Red Bluff Diversion Dam, flows would generally be similar between Existing Conditions and  
10 A2A\_LLT throughout the period.

11 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
12 examined during the January through April primary steelhead spawning and egg incubation period  
13 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
14 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
15 temperature between Existing Conditions and Alternative 2A in any month or water year type  
16 throughout the period at either location.

17 SacEFT predicts no differences in spawning habitat, egg incubation, and redd dewatering risk  
18 between Existing Conditions and Alternative 2A, and negligible changes (<5%) in redd scour risk  
19 (Table 11-2A-15).

20 Overall in the Sacramento River, Alternative 2A would have negligible reductions in mean monthly  
21 flow (-6%) that would not affect steelhead spawning conditions in a biological meaningful way.  
22 SacEFT indicates that steelhead egg incubation and redd survival metrics would not be substantially  
23 affected by Alternative 2A. Impacts of Alternative 2A on water temperature would be less than  
24 significant.

25 **Clear Creek**

26 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period  
27 (January through April). Flows under A2A\_LLT would be similar to or greater than flows under  
28 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*  
29 *Fish Analysis*).

30 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest  
31 monthly flow reduction would be identical between Existing Conditions and A2A\_LLT for all water  
32 year types except wet, in which the greatest reduction would be 38% lower (worse) under A2A\_LLT  
33 than under Existing Conditions (Table 11-2A-50).

34 No water temperature modeling was conducted in Clear Creek.

35 Overall, these results indicate that the effects of Alternative 2A on steelhead spawning and egg  
36 incubation habitat in Clear Creek would be negligible.

37 **Feather River**

38 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and  
39 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation  
40 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
41 Flows in the low-flow channel under A2A\_LLT would not differ from Existing Conditions because

1 minimum Feather River flows are included in the FERC settlement agreement and would be met for  
2 all model scenarios (California Department of Water Resources 2006). Flows under A2A\_LLT at  
3 Thermalito Afterbay would generally be similar to or greater than flows under Existing Conditions,  
4 except in above and below normal water years during January (36% and 44% lower, respectively),  
5 below normal, dry and critical water years during February (45%, 11%, and 8% lower, respectively),  
6 and below normal and dry water years during March (46% and 5% lower, respectively).

7 Oroville Reservoir storage volume at the end of September and end of May influences flows  
8 downstream of the dam during the steelhead spawning and egg incubation period. Oroville  
9 Reservoir storage volume at the end of September would be 7% to 36% lower under A2A\_LLT  
10 relative to Existing Conditions depending on water year type (Table 11-2A-25). May Oroville storage  
11 volume under A2A\_LLT would be lower than Existing Conditions by 6% to 21% depending on water  
12 year type, except in wet years, in which storage would be similar to Existing Conditions (Table 11-  
13 2A-28).

14 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito  
15 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January  
16 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*  
17 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the  
18 low-flow channel, mean monthly water temperatures under Alternative 2A would be 5% to 8%  
19 greater than those under Existing Conditions during January through March and similar to  
20 temperatures under Existing Conditions during April. In the high-flow channel, mean monthly water  
21 temperatures under Alternative 2A would be 7% greater than those under Existing Conditions  
22 during January and February and similar to temperatures under Existing Conditions during March  
23 and April except for below normal and critical years during March (6% greater for both years).

24 The percent of months exceeding the 56°F temperature threshold in the Feather River above  
25 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-2A-  
26 51). The percent of months exceeding the threshold under Alternative 2A would generally be similar  
27 to the percent under Existing Conditions during January and February and similar to or up to 32%  
28 greater (absolute scale) than the percent under Existing Conditions depending on month and  
29 degrees above the threshold during March and April.

30 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito  
31 Afterbay (low-flow channel) during January through April (Table 11-2A-52). Total degree-months  
32 would be similar between Existing Conditions and Alternative 2A during January and February and  
33 664% to 1300% higher under Alternative 2A compared to Existing Conditions during March and  
34 April.

35 Overall, these results indicate that there would be negligible effects of Alternative 2A on mean  
36 monthly flows in the low-flow channel, but that flows in the high-flow channel would be  
37 substantially lower in some water year types and months. Alternative 2A would substantially  
38 increase exposure of spawning steelhead and their eggs to critical water temperatures, a result of  
39 reduced coldwater pool availability in Oroville Reservoir.

#### 40 ***American River***

41 Flows in the American River at the confluence with the Sacramento River were examined for the  
42 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
43 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be lower than

1 flows under Existing Conditions during January, greater than flows under Existing Conditions during  
2 February and March, and similar to flows under Existing Conditions during April with some  
3 exceptions. Mean monthly water temperatures in the American River at the Watt Avenue Bridge  
4 were evaluated during the January through April steelhead spawning and egg incubation period  
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
6 *utilized in the Fish Analysis*). Mean monthly water temperature under Alternative 2A would be 5% to  
7 7% higher than those under Existing Conditions during the period.

8 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
9 Avenue Bridge was evaluated during November through April (Table 11-2A-41). Steelhead spawn  
10 and eggs incubate in the American River between January and April. During January and February,  
11 the percent of month exceeding the threshold under Existing Conditions and Alternative 2A would  
12 be identical. During March and April, the percent of months exceeding the threshold under  
13 Alternative 2A would be up to 31% greater (absolute scale) than the percent under Existing  
14 Conditions.

15 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
16 Avenue Bridge during November through April (Table 11-2A-42). During the January and February,  
17 there would be no difference in total degree-months above the threshold between Existing  
18 Conditions and Alternative 2A. During March and April, total degree-months under Alternative 2A  
19 would be 389% and 94% greater than those under Existing Conditions, respectively.

20 Overall, these results indicate that the effects of Alternative 2A on flows would not be negative.  
21 Flows would be mostly greater than flows under Existing Conditions and temperatures would not  
22 differ from Existing Conditions. However, Alternative 2A would substantially increase exposure of  
23 spawning steelhead and their eggs to critical water temperatures.

#### 24 ***Stanislaus River***

25 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
26 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT throughout this period would be up  
28 to 36% lower flows under Existing Conditions in all months with few exceptions.

29 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was  
30 evaluated during the January through April steelhead spawning and egg incubation period  
31 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
32 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would be 6%  
33 higher than those under Existing Conditions in all months.

#### 34 ***San Joaquin River***

35 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 36 ***Mokelumne River***

37 Flows in the Mokelumne River at the Delta were examined during the January through April  
38 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
39 *Fish Analysis*). Flows under A2A\_LLT would generally be similar to or up to 18% higher than flows  
40 under Existing Conditions during January through March and up to 14% lower during April.

41 Water temperature modeling was not conducted in the Mokelumne River.

## 1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between  
3 the CEQA baseline and Alternative 2A could be significant because, when compared to the CEQA  
4 baseline, the alternative could substantially reduce suitable spawning habitat or substantially  
5 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth  
6 above.

7 Alternative 2A substantial reductions in mean monthly flow in the Stanislaus River and increased  
8 exposure to elevated water temperatures in the Feather, American, and Stanislaus Rivers. There  
9 would be beneficial effects due to moderate increases in mean monthly flow for specific months and  
10 water year types in Clear Creek and the American River, primarily in wetter water year types, and in  
11 the Feather River primarily during wetter water years but also in drier water year types in April.  
12 These would not offset the negative effects of the more persistent and/or substantial flow  
13 reductions. There would be no effects in the Sacramento River.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
15 change, future water demands, and implementation of the alternative. The analysis described above  
16 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
17 the alternative from those of sea level rise, climate change and future water demands using the  
18 model simulation results presented in this chapter. However, the increment of change attributable  
19 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
20 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
21 implementation period, which does include future sea level rise, climate change, and water  
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
26 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
27 locations and during the months analyzed above would generally be similar between Existing  
28 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
29 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
30 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
31 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
32 therefore would not in itself result in a significant impact on spawning and egg incubation habitat  
33 for steelhead salmon. This impact is found to be less than significant and no mitigation is required.

## 34 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

35 In general, Alternative 2A would reduce the quantity and quality of steelhead rearing habitat  
36 relative to NAA.

### 37 ***Sacramento River***

38 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream  
39 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in  
40 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the  
41 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to  
42 upstream of RBDD) were evaluated (*Appendix 11C, CALSIM II Model Results utilized in the Fish*

1 *Analysis*). Flows during September, October, and between December and July under A2A\_LLT would  
2 generally be similar to or greater than those under NAA. Flows during August and November would  
3 generally be lower under A2A\_LLT than under NAA.

4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
5 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
6 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
7 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative  
8 2A in any month or water year type throughout the period at either location.

9 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions  
10 under A2A\_LLT would be 22% lower (10% on absolute scale) than that under NAA (Table 11-2A-  
11 49). Also, the percentage of years with good (lower) juvenile stranding risk conditions under  
12 A2A\_LLT would be 10% lower (2% on absolute scale) than under NAA. These results indicate that  
13 Alternative 2A would cause a small decrease in rearing habitat availability in the Sacramento River.

14 Overall, these results indicate that Alternative 2A would reduce juvenile rearing conditions in the  
15 Sacramento River.

16 **Clear Creek**

17 Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under  
18 A2A\_LLT would generally be similar to or greater than flows under NAA, except for critical years in  
19 February and June and below normal years in March in which flows would be 6% to 8% lower  
20 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Water temperatures were not  
21 modeled in Clear Creek.

22 It was assumed that habitat for juvenile steelhead rearing would be constrained by the month  
23 having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows  
24 increase, and therefore the lowest monthly instream flow was used as an index of habitat  
25 constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing  
26 habitat, based on minimum instream flows, is comparable for Alternative 2A relative to NAA in wet,  
27 above normal, and critical water year types (Table 11-2A-53). Minimum flows would be 86% higher  
28 in below normal years and 100% lower (reduction from 7 cfs to 0 cfs) in dry water years.

29 **Table 11-2A-53. Difference (cfs) and Percent Difference in Minimum Monthly Mean Flow in Clear**  
30 **Creek during the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	15 (21%)	39 (86%)
Dry	-50 (-100%)	-7 (-100%)
Critical	-50 (-100%)	0 (NA)

Note: Minimum flows occurred between October and March.  
NA = could not be calculated because the denominator was 0.

31  
32 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-  
33 1A-4). The current Clear Creek management regime uses flows slightly lower than those

1 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being  
2 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We  
3 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.  
4 No change in effect on steelhead in Clear Creek is anticipated.

5 Overall, these results indicate that Alternative 2A would not affect juvenile rearing conditions in  
6 Clear Creek.

### 7 **Feather River**

8 Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay  
9 (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing  
10 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is  
11 the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al.  
12 2003). Relatively constant flows in the low flow channel throughout the year under A2A\_LLT would  
13 not differ from those under NAA. In the high flow channel, flows under A2A\_LLT would be mostly  
14 lower (up to 50%) during July, August, November, December, and February and mostly similar to or  
15 greater (up to 217%) than flows under Existing Conditions in other months.

16 May Oroville storage under A2A\_LLT would be similar to storage under NAA (Table 11-2A-28).  
17 September Oroville storage volume would be similar to or up to 5% lower than under NAA  
18 depending on water year type (Table 11-2A-25).

19 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
20 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
21 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature  
22 Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
23 water temperature between NAA and Alternative 2A in any month or water year type throughout  
24 the period at either location.

25 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in  
26 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and  
27 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-  
28 flow channel, the percent of months exceeding the threshold under Alternative 2A would generally  
29 be similar to or lower (up to 23% lower on an absolute scale) than the percent under NAA (Table  
30 11-2A-29). At Gridley, the percent of months exceeding the threshold under Alternative 2A would  
31 be similar to or up to 11% lower (absolute scale) than the percent under NAA (Table 11-2A-38).

32 Total degree-months exceeding 56°F were summed by month and water year type in the Feather  
33 River above Thermalito Afterbay (low-flow channel) and at Gridley during November through April.  
34 In the low-flow channel, total degree-months under Alternative 2A would be similar to or lower than  
35 those under NAA depending on the month (Table 11-2A-30). At Gridley, total degree-months would  
36 be similar between NAA and Alternative 2A for December through February, while for October  
37 through April degree-months would be 6% to 33% lower under Alternative 2A (Table 11-2A-39).

38 Overall, these results indicate that there would be effects of Alternative 2A on flows during the  
39 juvenile steelhead rearing period in the Feather River.

1     **American River**

2     Flows in the American River at the confluence with the Sacramento River were examined for the  
3     year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4     *Analysis*). Flows under A2A\_LLT would generally be similar to flows under NAA during January  
5     through April and October through December, greater than flows under NAA during May and June,  
6     and lower than flows under NAA during July through September.

7     Mean monthly water temperatures in the American River at the confluence with the Sacramento  
8     River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
9     (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
10     *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
11     temperature between NAA and Alternative 2A in any month or water year type throughout the  
12     period.

13     The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
14     Avenue Bridge was evaluated during May through October (Table 11-2A-54). During May, June, and  
15     October, the percent of months exceeding the threshold under Alternative 2A would similar to or up  
16     to 23% lower (absolute scale) than the percent under NAA. During July through September, the  
17     percent of months exceeding the threshold would mostly be similar between NAA and Alternative  
18     2A with three degree categories in which there would be decreases of up to 6% on an absolute scale  
19     in percent of months exceeding the threshold under Alternative 2A and one degree category in  
20     which there would be an increase of 6% on the absolute scale.

21     Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
22     Avenue Bridge during May through October (Table 11-2A-55). During May, June, and October, total  
23     degree-months would be similar between NAA and Alternative 2A or up to 14% lower under  
24     Alternative 2A. During July through September, there would be 2% to 7% increases in total degree-  
25     months exceeding the threshold.

1 **Table 11-2A-54. Differences between Baseline and Alternative 2A Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**  
 3 **River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LL1</b>					
May	33 (169%)	26 (175%)	20 (178%)	14 (220%)	6 (125%)
June	33 (52%)	33 (63%)	17 (42%)	11 (36%)	10 (47%)
July	0 (0%)	1 (1%)	31 (49%)	36 (100%)	38 (221%)
August	0 (0%)	2 (3%)	19 (23%)	51 (105%)	65 (212%)
September	15 (17%)	41 (77%)	53 (165%)	54 (338%)	47 (633%)
October	73 (1,475%)	47 (1,900%)	36 (NA)	20 (NA)	11 (NA)
<b>NAA vs. A2A_LL1</b>					
May	-11 (-17%)	-9 (-18%)	-9 (-22%)	-12 (-38%)	-6 (-36%)
June	-1 (-1%)	-5 (-5%)	-23 (-29%)	-23 (-36%)	-17 (-36%)
July	0 (0%)	0 (0%)	-4 (-4%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	2 (3%)	6 (7%)
September	0 (0%)	-4 (-4%)	0 (0%)	-4 (-5%)	-6 (-10%)
October	-2 (-3%)	-16 (-25%)	-10 (-22%)	-10 (-33%)	0 (0%)
NA = could not be calculated because the denominator was 0.					

4

1 **Table 11-2A-55. Differences between Baseline and Alternative 2A Scenarios in Total**  
 2 **Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances**  
 3 **above 65°F in the American River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLТ	NAA vs. A2A_LLТ
May	Wet	20 (333%)	-1 (-4%)
	Above Normal	21 (NA)	-6 (-22%)
	Below Normal	17 (567%)	-6 (-23%)
	Dry	22 (100%)	-12 (-21%)
	Critical	33 (174%)	1 (2%)
	All	113 (226%)	-24 (-13%)
June	Wet	45 (265%)	-23 (-27%)
	Above Normal	19 (79%)	-13 (-23%)
	Below Normal	27 (93%)	-11 (-16%)
	Dry	34 (50%)	-6 (-6%)
	Critical	46 (92%)	-4 (-4%)
	All	170 (90%)	-58 (-14%)
July	Wet	56 (72%)	7 (6%)
	Above Normal	13 (48%)	7 (21%)
	Below Normal	28 (82%)	7 (13%)
	Dry	63 (102%)	12 (11%)
	Critical	46 (57%)	0 (0%)
	All	207 (73%)	34 (7%)
August	Wet	104 (132%)	-4 (-2%)
	Above Normal	37 (90%)	4 (5%)
	Below Normal	52 (93%)	15 (16%)
	Dry	95 (140%)	14 (9%)
	Critical	69 (87%)	5 (3%)
	All	356 (110%)	33 (5%)
September	Wet	80 (333%)	6 (6%)
	Above Normal	42 (263%)	6 (12%)
	Below Normal	49 (175%)	2 (3%)
	Dry	81 (193%)	-5 (-4%)
	Critical	53 (108%)	0 (0%)
	All	305 (192%)	9 (2%)
October	Wet	49 (4,900%)	-5 (-9%)
	Above Normal	27 (NA)	1 (4%)
	Below Normal	37 (NA)	-2 (-5%)
	Dry	37 (NA)	0 (0%)
	Critical	30 (600%)	0 (0%)
	All	179 (2,983%)	-7 (-4%)

NA = could not be calculated because the denominator was 0.

4  
 5 Overall, these results indicate that effects of Alternative 2A on juvenile steelhead rearing habitat in  
 6 the American River would be biologically meaningful during summer months.

1 **Stanislaus River**

2 Flows in the Stanislaus River under Alternative 2A would not differ from those under NAA  
3 throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and  
5 Alternative 2A throughout the year-round period (Appendix 11D, *Sacramento River Water Quality  
6 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

7 **San Joaquin River**

8 Flows in the San Joaquin River under Alternative 2A would not differ from those under NAA  
9 throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Water temperature modeling was not conducted in the San Joaquin River.

11 **Mokelumne River**

12 Flows in the Mokelumne River under Alternative 2A would not differ from those under NAA  
13 throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Water temperature modeling was not conducted in the Mokelumne River.

15 **NEPA Effects:** Collectively, it is concluded that the effect of Alternative 2A is adverse relative to NAA  
16 because it has the potential to substantially reduce rearing habitat. There would be small to  
17 moderate reductions in flows during substantial portions of the juvenile steelhead rearing period in  
18 the Sacramento, Feather, and American rivers. SacEFT predicts a small reduction in rearing habitat  
19 availability in the Sacramento River. There would be no effect on water temperatures in these rivers.  
20 Further, there would be no change in flows in any other river or on water temperature in the  
21 Stanislaus River.

22 **CEQA Conclusion:** In general, Alternative 2A would reduce the quantity and quality of steelhead  
23 rearing habitat relative to Existing Conditions.

24 **Sacramento River**

25 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and  
26 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM  
27 II Model Results utilized in the Fish Analysis*). Flows during October and between December and July  
28 under A2A\_LL1T would generally be similar to or greater than those under Existing Conditions. Flows  
29 during August, September and November would generally be lower under A2A\_LL1T than under  
30 Existing Conditions.

31 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
32 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River  
33 Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At  
34 both locations, mean monthly water temperatures under Alternative 2A would generally be similar  
35 to those under Existing Conditions, except during July through October, in which there would be 5%  
36 to 10% higher temperatures under Alternative 2A.

37 SacEFT predicts that there would be a 15% decrease in the percentage of years with good rearing  
38 availability, measured as weighted usable area, under A2A\_LL1T relative to Existing Conditions  
39 (Table 11-2A-49). SacEFT predicts that there would be a substantial reduction (-47%) in the

1 number of years with good (lower) juvenile stranding risk under A2A\_LLT relative Existing  
2 Conditions.

3 Overall, these results indicate that Alternative 2A would have biologically meaningful effects on  
4 juvenile rearing success in the Sacramento River. Alternative 2A would cause small reductions in  
5 mean monthly flows during three months of the year and SacEFT predicts that juvenile habitat area  
6 would be reduced and stranding risk would be substantially increased by 47% Water temperatures  
7 would be higher during 4 of 12 months.

### 8 **Clear Creek**

9 Flows in Clear Creek during the year-round rearing period under A2A\_LLT would generally be  
10 similar to or greater than flows under Existing Conditions, except for critical years in February and  
11 August through December in which flows would be 6% to 29% lower (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*).

13 Water temperatures were not modeled in Clear Creek.

14 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and  
15 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile  
16 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream  
17 flows affecting juvenile rearing habitat are shown in Table 11-2A-53. Results indicate that  
18 Alternative 2A would have no effect on juvenile rearing habitat, based on minimum instream flows,  
19 compared to Existing Conditions in wet and above normal water years. Minimum flows would be  
20 21% greater in below normal years and 100% lower in dry and critical years (reduction from 50 cfs  
21 to 0 cfs.

22 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-  
23 1A-4). The current Clear Creek management regime uses flows slightly lower than those  
24 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being  
25 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We  
26 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.  
27 No change in effect on steelhead in Clear Creek is anticipated.

28 Overall in Clear Creek, Alternative 2A would result in no biologically meaningful changes in mean  
29 monthly flow that would affect juvenile rearing habitats.

### 30 **Feather River**

31 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and  
32 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 2A relative to  
33 Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period  
34 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at  
35 Thermalito Afterbay), flows under A2A\_LLT would be mostly lower (up to 50%) during February  
36 July, August, November, and December, and mostly similar to or greater (up to 217%) than flows  
37 under Existing Conditions in other months.

38 May Oroville storage volume under A2A\_LLT would be lower than Existing Conditions by 6% to 21%  
39 depending on water year type, except in wet years, in which storage would be similar to Existing  
40 Conditions (Table 11-2A-28).

1 As reported in Impact AQUA-58 for spring-run Chinook salmon, September Oroville storage volume  
2 would be 7% to 36% lower under A2A\_LLT relative to Existing Conditions depending on water year  
3 type (Table 11-2A-25).

4 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
5 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
6 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature  
7 Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water  
8 temperatures under Alternative 2A would be similar to those under Existing Conditions between  
9 April and August, but would be 5% to 10% higher between October and March. In the high-flow  
10 channel, mean monthly water temperatures under Alternative 2A would be similar to those under  
11 Existing Conditions between April through June and September, but would be 5% to 9% higher in  
12 the remaining eight months.

13 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in  
14 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and  
15 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-  
16 flow channel, the percent of months exceeding the threshold under Alternative 2A would generally  
17 be similar to the percent under Existing Conditions during May, and similar or up to 51% (absolute  
18 scale) higher than the percent under Existing Conditions during June through August (Table 11-2A-  
19 29). At Gridley, the percent of months exceeding the threshold under Alternative 2A would similar  
20 to the percent under Existing Conditions during December through February, but similar to or up to  
21 47% greater (absolute scale) than the percent under Existing Conditions in the remaining 4 months  
22 (Table 11-2A-38).

23 Total degree-months exceeding 56°F were summed by month and water year type in the Feather  
24 River above Thermalito Afterbay (low-flow channel) (May through August) at Gridley during  
25 October through April. In the low-flow channel, total degree-months under Alternative 2A would be  
26 similar to those under Existing Conditions during May and 51% to 159% higher during June through  
27 August (Table 11-2A-30). At Gridley, total degree-months under Alternative 2A would be similar to  
28 those under Existing Conditions during December through and February and 18% to 2500% greater  
29 than those under Existing Conditions in the remaining months of the period (Table 11-2A-39).

30 Overall, these results indicate that Alternative 2A would affect juvenile steelhead rearing conditions  
31 in the Feather River. Fish rearing in the high-low channel would experience lower flows during  
32 multiple months and fish rearing in both the low- and high-flow channels would experience  
33 increased exceedances of water temperature thresholds.

#### 34 **American River**

35 Flows in the American River at the confluence with the Sacramento River were examined for the  
36 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
37 Analysis*). Flows under A2A\_LLT would be up to 27% greater than to flows under Existing Conditions  
38 during February March, and June, similar to flows under Existing Conditions during April and  
39 October, and up to 56% lower than flows under Existing Conditions during the remaining seven  
40 months of the year.

41 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
42 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
43 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*

1 *utilized in the Fish Analysis*). There would be temperature increases (>5%) of 5% to 13% in most  
2 water year types in most months although only in one water year in June and in two water years in  
3 July between Existing Conditions and Alternative 2A.

4 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
5 Avenue Bridge was evaluated during May through October (Table 11-2A-54). In comparison to  
6 Existing Conditions the temperatures would be exceeded under Alternative 2A in all degree  
7 categories in all months (by 2% to 73% on the absolute scale) except for the > 1°F category during  
8 July and August.

9 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
10 Avenue Bridge during May through October (Table 11-2A-55). During all months, total degree-  
11 months would be higher under Alternative 2A compared to Existing Conditions by 48% to 4900%.

12 Overall, these results indicate that there would be substantial effects of Alternative 2A on juvenile  
13 steelhead rearing habitat in the American River during many months of the year.

#### 14 ***Stanislaus River***

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
16 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
17 *Analysis*). There would be flow reductions (up to 36%) under Alternative 2A relative to Existing  
18 Conditions in all months.

19 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
20 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,  
21 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
22 *Fish Analysis*). Mean monthly water temperatures under Alternative 2A would be 5% to 6% higher  
23 in all months except June, July, and October.

#### 24 ***San Joaquin River***

25 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
26 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative  
27 2A would be 5% to 33% lower than flows under Existing Conditions during March through October,  
28 similar to flows under Existing Conditions during November through February. Water temperature  
29 modeling was not conducted in the San Joaquin River.

#### 30 ***Mokelumne River***

31 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
32 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative  
33 2A would be similar to flows under Existing Conditions during March, up to 14% greater than flows  
34 under Existing Conditions during December through February, and up to 46% lower than flows  
35 under Existing Conditions during April through November.

36 Water temperature modeling was not conducted in the Mokelumne River.

#### 37 **Summary of CEQA Conclusion**

38 Collectively, the results indicate that the effect is significant because the alternative could  
39 substantially reduce juvenile rearing habitat. Alternative 2A would cause reduced juvenile steelhead

1 rearing habitat conditions based primarily on flow reductions in the Sacramento, Feather, American,  
2 Stanislaus, San Joaquin, and Mokelumne rivers and degraded temperature conditions in the  
3 Sacramento, Feather, American, and Stanislaus Rivers. These flow reductions and temperature  
4 increases would affect the quantity and quality of juvenile rearing habitat and would contribute to  
5 reduced survival and increased stress.

6 Alternative 2A would cause reduced juvenile steelhead rearing habitat conditions in each of the  
7 rivers analyzed, based on flow reductions, particularly in drier water year types, in much of the year  
8 and increased exposure to water temperatures above critical thresholds in the Feather River. These  
9 flow reductions and temperature increases would affect the quantity and quality of juvenile rearing  
10 habitat and would contribute to reduced survival and increased stress, particularly in drier water  
11 years. This impact is a result of the specific reservoir operations and resulting flows associated with  
12 this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows)  
13 to the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
14 change the alternative, thereby making it a different alternative than that which has been modeled  
15 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
16 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
17 severity of impact though not necessarily to a less-than-significant level.

18 **Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional**  
19 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**  
20 **Reduce Impacts to Rearing Habitat.**

21 Although analysis conducted as part of the EIR/EIS determined that Alternative 2A would have  
22 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
23 best available scientific information at the time and may prove to have been overstated. Upon  
24 the commencement of operations of CM1 and continuing through the life of the permit, the  
25 BDCP proponents will monitor effects on rearing habitat in order to determine whether such  
26 effects would be as extensive as concluded at the time of preparation of this document and to  
27 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
28 measure requires a series of actions to accomplish these purposes, consistent with the  
29 operational framework for Alternative 2A.

30 The development and implementation of any mitigation actions shall be focused on those  
31 incremental effects attributable to implementation of Alternative 2A operations only.  
32 Development of mitigation actions for the incremental impact on rearing habitat attributable to  
33 climate change/sea level rise are not required because these changed conditions would occur  
34 with or without implementation of Alternative 2A.

35 **Mitigation Measure AQUA-95b: Conduct Additional valuation and Modeling of Impacts on**  
36 **Steelhead Rearing Habitat Following Initial Operations of CM1.**

37 Following commencement of initial operations of CM1 and continuing through the life of the  
38 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
39 modified operations could reduce impacts to rearing habitat under Alternative 2A. The analysis  
40 required under this measure may be conducted as a part of the Adaptive Management and  
41 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

1           **Mitigation Measure AQUA-95c: Consult with NMFS, USFWS and CDFW to Identify**  
2           **Potentially Feasible Means to Minimize Effects on Steelhead Habitat Consistent with CM1**

3           In order to determine the feasibility of reducing the effects of CM1 operations on steelhead  
4           habitat, the BDCP proponents will consult with NMFS, USFWS and CDFW to identify any feasible  
5           operational means to minimize effects on rearing habitat. Any such action will be developed in  
6           conjunction with the ongoing monitoring and evaluation of habitat conditions required by  
7           Mitigation Measure AQUA-95a.

8           If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
9           operational framework of Alternative 2A without causing new significant adverse impacts on  
10          other covered species, such means shall be implemented. If sufficient operational flexibility to  
11          reduce effects on steelhead habitat is not feasible under Alternative 2A operations, achieving  
12          further impact reduction pursuant to this mitigation measure would not be feasible under this  
13          Alternative, and the impact on steelhead would remain significant and unavoidable.

14          **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

15          In general, Alternative 2A would reduce steelhead migration conditions relative to NAA.

16          **Upstream of the Delta**

17          ***Sacramento River***

18          *Juveniles*

19          Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through  
20          May juvenile steelhead migration period. Flows under A2A\_LLTP would be 5% to 17% lower than  
21          flows under NAA during October depending on water year type and would be up to 13% higher  
22          during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
23          A2A\_LLTP in the remaining six months of the migration period would be similar to flows under NAA.

24          Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
25          during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
26          *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
27          There would be no differences (<5%) in mean monthly water temperature between NAA and  
28          Alternative 2A in any month or water year type throughout the period.

29          *Adults*

30          Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through  
31          March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
32          *the Fish Analysis*). Flows under A2A\_LLTP would be 5% to 17% lower than flows under NAA during  
33          October depending on water year type and similar to flows under NAA in the remaining six months  
34          of the period.

35          Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
36          during the September through March steelhead adult upstream migration period (Appendix 11D,  
37          *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
38          *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
39          NAA and Alternative 2A in any month or water year type throughout the period

1       **Kelts**

2       Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April  
3       steelhead kelt (post-spawning adult) downstream migration period (Appendix 11C, *CALSIM II Model*  
4       *Results utilized in the Fish Analysis*). Flows during these two months would not differ between NAA  
5       and A2A\_LLТ.

6       Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
7       during the March through April steelhead kelt downstream migration period (Appendix 11D,  
8       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
9       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
10      NAA and Alternative 2A in any month or water year type throughout the period

11      Overall, these results indicate that juvenile, adult, or kelt steelhead migration conditions in the  
12      Sacramento River would not be affected by Alternative 2A.

13      **Clear Creek**

14      Water temperatures were not modeled in Clear Creek.

15      **Juveniles**

16      Flows in Clear Creek during the October through May juvenile steelhead migration period under  
17      A2A\_LLТ would generally be similar to or greater than flows under NAA except in critical years  
18      during February (6% lower), and in below normal years in March (6% lower) (Appendix 11C,  
19      *CALSIM II Model Results utilized in the Fish Analysis*).

20      **Adults**

21      Flows in Clear Creek during the September through March adult steelhead migration period under  
22      A2A\_LLТ would generally be similar to flows under NAA except in critical years during February  
23      (6% lower), and in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results*  
24      *utilized in the Fish Analysis*).

25      **Kelt**

26      Flows in Clear Creek during the March through April steelhead kelt downstream migration period  
27      under A2A\_LLТ would generally be similar to flows under NAA except in below normal years in  
28      March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29      Overall, these results indicate that juvenile, adult, or kelt steelhead migration conditions in Clear  
30      Creek would not be affected by Alternative 2A.

31      **Feather River**

32      **Juveniles**

33      Flows in the Feather River at the confluence with the Sacramento River were examined during the  
34      October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
35      *utilized in the Fish Analysis*). Flows under A2A\_LLТ would be similar to or greater than flows under  
36      NAA in all months and water years except during November in above normal years (8% lower).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
2 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 NAA and Alternative 2A in any month or water year type throughout the period.

#### 6 **Adults**

7 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
8 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 33% lower than  
10 flows under NAA during September, up to 32% higher than flows under NAA during October, and  
11 generally similar to flows under NAA in the remaining five months of the period.

12 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
13 were evaluated during the September through March steelhead adult upstream migration period  
14 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
15 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
16 temperature between NAA and Alternative 2A in any month or water year type throughout the  
17 period

#### 18 **Kelt**

19 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
20 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
21 *Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to those under NAA in  
22 March and up to 20% greater than flows under NAA in April.

23 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
24 were evaluated during the March through April steelhead kelt downstream migration period  
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
26 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
27 temperature between NAA and Alternative 2A in any month or water year type throughout the  
28 period.

29 Overall, these results indicate that there would be negligible effects of Alternative 2A on steelhead  
30 juvenile, adult, and kelt migration conditions. There would be some flow-based beneficial effects in  
31 some months.

#### 32 **American River**

##### 33 **Juveniles**

34 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
35 October through May juvenile steelhead migration period. Flows under A2A\_LLT would generally be  
36 similar to flows under NAA except in wet and above normal water years during October (10% and  
37 7% lower, respectively), critical water years during November (9% lower), and dry and critical  
38 water years during March (6% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results*  
39 *utilized in the Fish Analysis*).

1 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
2 River were evaluated during the October through May juvenile steelhead migration period  
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
5 temperature between NAA and Alternative 2A in any month or water year type throughout the  
6 period.

#### 7 *Adults*

8 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
9 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
10 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 19% lower  
11 depending on water year type than flows under NAA during September and generally similar to  
12 flows under NAA in the remaining six months of the period.

13 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
14 River were evaluated during the September through March steelhead adult upstream migration  
15 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
16 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
17 temperature between NAA and Alternative 2A in any month or water year type throughout the  
18 period.

#### 19 *Kelt*

20 Flows in the American River at the confluence with the Sacramento River were evaluated for the  
21 March and April kelt migration period. Flows under A2A\_LLT would generally be similar to flows  
22 under NAA except in dry and critical years during March (6% and 7% lower, respectively)  
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
25 River were evaluated during the March through April steelhead kelt downstream migration period  
26 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
27 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
28 temperature between NAA and Alternative 2A in any month or water year type throughout the  
29 period.

30 Overall in the American River, these results indicate that Alternative 2A would not affect juvenile,  
31 adult, or kelt steelhead migration in a biologically meaningful way.

#### 32 ***Stanislaus River***

33 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 2A are not  
34 different from flows under NAA for any month. Therefore, there would be no effect of Alternative 2A  
35 on juvenile, adult, or kelt migration in the Stanislaus River.

36 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San  
37 Joaquin River for Alternative 2A are not different from flows under NAA for any month. Therefore,  
38 there would be no effect of Alternative 2A on juvenile, adult, or kelt migration in the Stanislaus  
39 River.

1       ***San Joaquin River***

2       Flows in the San Joaquin River at Vernalis for Alternative 2A are not different from flows under NAA  
3       for any month. Therefore, there would be no effect of Alternative 2A on juvenile, adult, or kelt  
4       migration in the San Joaquin River.

5       Water temperature modeling was not conducted in the San Joaquin River.

6       ***Mokelumne River***

7       Flows in the Mokelumne River at the Delta for Alternative 2A are not different from flows under  
8       NAA for any month. Therefore, there would be no effect of Alternative 2A on juvenile, adult, or kelt  
9       migration in the Mokelumne River.

10      Water temperature modeling was not conducted in the Mokelumne River.

11      **Through-Delta**

12      The approach for steelhead impact assessment is similar to that for Chinook salmon (see Impact  
13      AQUA-42 above for description of the approach). Although steelhead have a similar life history to  
14      salmon, there are a few marked differences: juvenile steelhead spend from 1 to 3 years rearing in  
15      upstream habitats and migrate downstream as larger juveniles (usually >200 mm) compared to  
16      Chinook salmon, and adults do not necessarily die after spawning but can return to the ocean to  
17      grow and reproduce again. Adults can return one to three times before dying. The post-spawned  
18      adult life stage is termed a kelt and is unique to steelhead.

19      Overall, juvenile steelhead can be found in the Delta during most months of the year, but the  
20      outmigration spans from October through May with a peak outmigration period in February and  
21      March. Adult steelhead can also be found in the Delta almost year round with the adult upstream  
22      migration from September through March with a peak December through February. The kelt  
23      outmigration follows on the upstream migration and spawning and therefore is January through  
24      April. Olfactory cues for upstream migrating adults were assessed using fingerprinting analysis to  
25      estimate the percentage of source water from the Sacramento and San Joaquin Rivers

26      ***Sacramento River***

27      *Juveniles*

28      Flows in the Sacramento River below the north Delta intakes during the juvenile steelhead  
29      migration period (October through May) under Alternative 2A would be similar to NAA. Juvenile  
30      steelhead and juvenile winter-run Chinook salmon migrate downstream during the same months  
31      and would be exposed to similar conditions. As discussed above in Impact AQUA-42, the five north  
32      Delta intakes structures of Alternative 1A would increase potential predation loss of migrating  
33      juvenile salmonids and would displace 22 acres of aquatic habitat. However, juvenile steelhead  
34      would be less vulnerable than winter-run Chinook salmon to predation associated with the intake  
35      facilities because of their greater size and strong swimming ability.

36      *Adults*

37      For Sacramento River steelhead, straying rates of adult hatchery-origin Chinook salmon that were  
38      released upstream of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-  
39      origin steelhead apparently have not been examined in detail, for this analysis of effects, it was

1 assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to  
2 straying have low importance under Existing Conditions for adult Sacramento River region  
3 steelhead.

4 As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin  
5 water at Collinsville was always slightly lower under Alternative 2A than for NAA during the  
6 September-March steelhead upstream migration period. Attraction flow, as estimated by the  
7 percentage of Sacramento River water at Collinsville, under Alternative 2A increased 13% in  
8 September and declined 1% to 9% during the October to March migration period for steelhead  
9 adults (Table 11-2A-56). The reductions in percentage are small in comparison with the magnitude  
10 of change in dilution reported to cause a significant change in migration by Fretwell (1989) and,  
11 therefore, are not expected to affect winter-run migration. While the proportion of Sacramento  
12 River flows would be reduced under Alternative 2A, the Sacramento River would still represent a  
13 substantial 62% to 78% of Delta flows and olfactory cues would still be strong for upstream  
14 migrating adults. However, uncertainty remains with regard to adult salmon behavioral response to  
15 anticipated changes in lower Sacramento River flow percentages. For further discussion of the topic  
16 see the analysis for Alternative 1A.

17 **Table 11-2A-56. Summary of Finger Printing Analysis of the Percentage (%) of Water at Collinsville**  
18 **that Originated in the Sacramento River and San Joaquin River during the Steelhead Migration**  
19 **Period for Alternative 2A**

Month	Percentage of Water			Difference	
	EXISTING CONDITIONS	NAA	A2A_LL	EXISTING CONDITIONS vs. A2A_LL	NAA vs. A2A_LL
<b>Sacramento River</b>					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
<b>San Joaquin River</b>					
September	0.3	0.1	1.3	1.0	1.2
October	0.2	0.3	3.6	3.4	3.3
November	0.4	1.0	5.4	5.0	4.4
December	0.9	1.0	3.0	2.1	2.0
January	1.6	1.7	3.2	1.6	1.5
February	1.4	1.5	3.8	2.4	2.3
March	2.6	2.8	6.1	3.5	3.3
Shading indicates 10% or greater difference in flow proportion.					

20

1 **San Joaquin River**

2 *Juveniles*

3 The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of  
4 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.  
5 There no flow changes associated with the Alternatives. Alternative 2A would have no effect on  
6 steelhead migration success through the Delta.

7 *Adults*

8 Little information currently exists as to the importance of Plan Area flows on the straying of adult  
9 San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon  
10 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of  
11 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including  
12 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region  
13 steelhead adults as well.

14 The percentage of water at Collinsville that originated from the San Joaquin River during the fall-run  
15 migration period (September to December) is small, typically 0.1% to less than 3% under NAA.  
16 Alternative 2A operations conditions would incrementally increase olfactory cues associated with  
17 the San Joaquin River, which would benefit adult steelhead migrating to the San Joaquin River.

18 Based on DPM results for Chinook salmon, the survival of juvenile steelhead through the Delta is not  
19 expected to decrease more than 1% (Impact AQUA-42 for Alternative 2A). Therefore, Alternative 2A  
20 would not negatively affect juvenile steelhead migration though the Delta. Based on expected  
21 Sacramento and San Joaquin River flows, adult steelhead olfactory cues and flows would be about  
22 the same for Alternatives 1A and 2A, resulting in similar impacts to adult steelhead upstream  
23 migration and kelt downstream migration. Therefore, Alternative 2A would not have a negative  
24 effect on adult, juvenile, or kelt steelhead migration through the Delta.

25 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 2A is adverse due to the  
26 cumulative effects associated with five north Delta intake facilities, including mortality related to  
27 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to  
28 reduced flows downstream of the intakes) associated with the five NDD intakes.

29 Upstream of the Delta, flow and water temperature conditions during juvenile, adult, and kelt  
30 steelhead migration periods under Alternative 2A would generally be similar to those under Existing  
31 Conditions in all rivers examined.

32 Adult attraction flows in the Delta under Alternative 2A would be lower than those under NAA, but  
33 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

34 Near-field effects of Alternative 2A NDD on steelhead from the Sacramento River and tributaries  
35 related to impingement and predation associated with five new intakes could result in substantial  
36 effects on juvenile migrating steelhead, although there is high uncertainty regarding the potential  
37 effects. Estimates within the effects analysis range from very low levels of effects (<2% mortality) to  
38 very significant effects (~ 19% mortality above current baseline levels). CM15 would be  
39 implemented with the intent of providing localized and temporary reductions in predation pressure  
40 at the NDD. Additionally, several pre-construction surveys to better understand how to minimize  
41 losses associated with the five new intake structures will be implemented as part of the final NDD

1 screen design effort. Alternative 2A also includes an Adaptive Management Program and Real-Time  
2 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
3 adequate migration conditions for steelhead. However, at this time, due to the absence of  
4 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality  
5 expected from near-field effects at the NDD remains highly uncertain.

6 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
7 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
8 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 2A  
9 predict improvements in smolt condition and survival associated with increased access to the Yolo  
10 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
11 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
12 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

13 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
14 all of these elements of BDCP operations and conservation measures to predict smolt migration  
15 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
16 migration survival under Alternative 2A would be similar to survival rates estimated for NAA.  
17 Further refinement and testing of the DPM, along with several ongoing and planned studies related  
18 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable  
19 future. These efforts are expected to improve our understanding of the relationships and  
20 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
21 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
22 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative  
23 2A on steelhead through-Delta survival remains uncertain.

24 Therefore, primarily as a result of unacceptable levels of uncertainty regarding the cumulative  
25 impacts of near-field and far-field effects associated with the presence and operation of the five  
26 intakes on steelhead, this effect is adverse.

27 While the implementation of the conservation and mitigation measures described below would  
28 address these impacts, these measures are not anticipated to reduce the impact to a level considered  
29 not adverse.

30 **CEQA Conclusion:** In general, under Alternative 2A water operations, the quantity and quality of  
31 steelhead migration habitat would not be affected relative to the CEQA baseline.

## 32 **Upstream of the Delta**

### 33 ***Sacramento River***

#### 34 *Juveniles*

35 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through  
36 May juvenile steelhead migration period. Flows under A2A\_LL1T would be up to 13% lower than  
37 flows under Existing Conditions during November but would generally not differ between model  
38 scenarios for the remaining seven months of the migration period (Appendix 11C, *CALSIM II Model*  
39 *Results utilized in the Fish Analysis*).

40 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
41 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*

1 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis).*  
2 There would be no differences (<5%) in mean monthly water temperature between Existing  
3 Conditions and Alternative 2A in all months but October, in which temperatures under Alternative  
4 2A would be 6% greater than those under Existing Conditions.

#### 5 *Adults*

6 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through  
7 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
8 *the Fish Analysis*). Flows under A2A\_LLТ would be up to 13% lower than flows under Existing  
9 Conditions during November but would generally not differ between model scenarios for the  
10 remaining six months of the migration period.

11 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
12 during the September through March steelhead adult upstream migration period (Appendix 11D,  
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
15 Existing Conditions and Alternative 2A in all months except September and October, in which  
16 temperatures under Alternative 2A would be 5% to 12% greater than those under Existing  
17 Conditions.

#### 18 *Kelts*

19 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April  
20 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
21 *Fish Analysis*). Flows under A2A\_LLТ would generally be similar to those under Existing Conditions  
22 except in below normal water years during March (7% lower). Mean monthly water temperatures in  
23 the Sacramento River upstream of Red Bluff were evaluated during the March through April  
24 steelhead kelt downstream migration period (Appendix 11D, *Sacramento River Water Quality Model*  
25 *and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
26 differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative  
27 2A in any month or water year type throughout the period.

28 Overall in the Sacramento River, these results indicate that there would be no biologically  
29 meaningful impacts of Alternative 2A on juvenile, adult, and kelt migration.

#### 30 **Clear Creek**

31 Water temperatures were not modeled in Clear Creek.

#### 32 *Juveniles*

33 Flows in Clear Creek during the October through May juvenile steelhead migration period under  
34 A2A\_LLТ would generally be similar to or greater than flows under Existing Conditions except in  
35 critical years during October (7% lower) and November (6% lower) (Appendix 11C, *CALSIM II*  
36 *Model Results utilized in the Fish Analysis*).

#### 37 *Adults*

38 Flows in Clear Creek during the September through March adult steelhead migration period under  
39 A2A\_LLТ would generally be similar to flows under Existing Conditions except in critical years

1 during September (29% lower), October (7% lower), and November (6% lower) (Appendix 11C,  
2 *CALSIM II Model Results utilized in the Fish Analysis*).

### 3 *Kelt*

4 Flows in Clear Creek during the March through April steelhead kelt downstream migration period  
5 under A2A\_LLT would generally be similar to or greater than flows under Existing Conditions  
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Overall, these results indicate that Alternative 2A would not affect juvenile, adult, or kelt migration  
8 conditions in Clear Creek.

## 9 **Feather River**

### 10 *Juveniles*

11 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
12 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
13 *utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 32% greater than flows under  
14 Existing Conditions during October, up to 20% lower than flows under Existing Conditions during  
15 November, and similar to flows under Existing Conditions in the remaining six months of the period.

16 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
18 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
19 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
20 Existing Conditions and Alternative 2A in all months except November and December and two water  
21 years in October, in which temperatures under Alternative 2A would be 6% greater than  
22 temperatures under Existing Conditions.

### 23 *Adults*

24 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
25 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be up to 113% greater than  
27 flows under Existing Conditions during September and October, up to 20% lower than flows under  
28 Existing Conditions during November, and similar to flows under Existing Conditions in the  
29 remaining four months of the period.

30 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
31 were evaluated during the September through March steelhead adult upstream migration period  
32 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
33 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
34 temperature between Existing Conditions and Alternative 2A during January through March. During  
35 November and December, temperatures under Alternative 2A would be 5% greater than  
36 temperatures under Existing Conditions. Temperatures in three water years during September and  
37 two water years during October would be 5% greater than temperatures under Existing Conditions.

### 38 *Kelt*

39 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
40 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*

1 *Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be similar to or up to 19% greater  
2 than flows under Existing Conditions except in below normal water years during March (18%  
3 lower).

4 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
5 were evaluated during the March through April steelhead kelt downstream migration period  
6 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
7 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
8 temperature between Existing Conditions and Alternative 2A in any month or water year type  
9 throughout the period.

10 Overall, these results indicate that migration conditions for steelhead in the Feather River would not  
11 be affected by Alternative 2A. Flows and temperatures would be mostly similar between Existing  
12 Conditions and Alternative 2A.

### 13 **American River**

#### 14 *Juveniles*

15 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
16 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
17 *utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be up to 27% greater than flows  
18 under Existing Conditions during February and March. Flows under A2A\_LLT would generally be up  
19 to 33% lower than flows under Existing Conditions during November through January and May.  
20 Flows would be similar to those under Existing Conditions during October and April.

21 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
22 River were evaluated during the October through May juvenile steelhead migration period  
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
24 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would be 5%  
25 to 12% higher than those under Existing Conditions in all months during the period except April  
26 when only one water year would reach the 5% value.

#### 27 *Adults*

28 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
29 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
30 *Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would generally be up to 27%  
31 greater than flows under Existing Conditions during February and March. Flows under A2A\_LLT  
32 would generally be up to 33% lower than flows under Existing Conditions during September and  
33 November through January. Flows would be similar to those under Existing Conditions during  
34 October.

35 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
36 River were evaluated during the September through March steelhead adult upstream migration  
37 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
38 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would  
39 be 5% to 12% higher than those under Existing Conditions in all months during the period.

1 **Kelt**

2 Flows in the American River at the confluence with the Sacramento River were evaluated for the  
3 March and April kelt migration period. Flows under A2A\_LL1T would generally be up to 14% greater  
4 than flows under Existing Conditions during March and generally similar to flows under Existing  
5 Conditions during April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
7 River were evaluated during the March and April kelt migration period (Appendix 11D, *Sacramento  
8 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
9 Mean monthly water temperatures under Alternative 2A would be 5% higher than those under  
10 Existing Conditions in March but temperatures would be similar between Existing Conditions and  
11 Alternative 2A during April.

12 Overall, these results indicate that Alternative 2A would reduce juvenile and adult migration  
13 conditions during a portion of their respective migration periods, but not kelt migration.

14 **Stanislaus River**

15 *Juveniles*

16 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
17 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II  
18 Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 2A would be 6% to  
19 16% lower than flows under Existing Conditions depending on month except during January, in  
20 which there would be no difference.

21 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
22 River were evaluated during the October through May steelhead juvenile downstream migration  
23 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model  
24 Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would  
25 be 6% higher than those under Existing Conditions in all months during the period except October,  
26 in which temperature would be similar between Existing Conditions and Alternative 2A.

27 *Adults*

28 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
29 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II  
30 Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 2A would be 6% to  
31 16% lower than flows under Existing Conditions depending on month, except during January, in  
32 which there would be no differences.

33 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
34 River were evaluated during the September through March steelhead adult upstream migration  
35 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model  
36 Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would  
37 be 6% higher than those under Existing Conditions in all months during the period except October,  
38 in which temperature would be similar between Existing Conditions and Alternative 2A.

1 **Kelt**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
3 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
4 *Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 2A would be 8% to 11%  
5 lower than flows under Existing Conditions during March and April, respectively.

6 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
7 River were evaluated during the March and April steelhead kelt downstream migration period  
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
9 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 2A would be 6%  
10 higher than those under Existing Conditions during March and April.

11 **San Joaquin River**

12 Water temperature modeling was not conducted in the San Joaquin River.

13 **Juveniles**

14 Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead  
15 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
16 *Analysis*). Mean monthly flows under Alternative 2A would 5% greater than flows under Existing  
17 Conditions during January, 5% lower during October and in drier years during March, April, and  
18 May, and similar in the remaining 3 months of the period.

19 **Adults**

20 Flows in the San Joaquin River at Vernalis were evaluated for the September through March  
21 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
22 *Fish Analysis*). Mean monthly flows under Alternative 2A would 5% greater than flows under  
23 Existing Conditions during January, 8% lower during September and in drier years during March,  
24 and similar in the remaining 4 months of the period.

25 **Kelt**

26 Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt  
27 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
28 Flows under Alternative 2A would be similar to flows under Existing Conditions during wet and  
29 above normal water years and up to 16% lower during below normal, dry, and critical years in both  
30 March and April.

31 **Mokelumne River**

32 Water temperature modeling was not conducted in the Mokelumne River.

33 **Juveniles**

34 Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead  
35 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
36 *Analysis*). Mean monthly flows under Alternative 2A would be similar to flows under Existing  
37 Conditions during March, 5% to 12% lower than flows under Existing Conditions during October,

1 November, April, and May, and 12% to 14% higher than flows under Existing Conditions during  
2 December through February.

3 *Adults*

4 Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead  
5 adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Mean monthly flows under Alternative 2A would be similar to flows under Existing  
7 Conditions during March, 5% to 27% lower than flows under Existing Conditions during September,  
8 October, and November, and 12% to 14% higher than flows under Existing Conditions during  
9 December through February.

10 *Kelt*

11 Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt  
12 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
13 Mean monthly flows under Alternative 2A would be similar to flows under Existing Conditions  
14 during March and 8% lower during April.

15 **Through-Delta**

16 ***Sacramento River***

17 *Juveniles*

18 Juvenile steelhead migrating down the Sacramento River (October through May) would generally  
19 experience lower flows below the north Delta intakes compared to Existing Conditions. Through  
20 migrating juvenile Chinook salmon indicate that at these magnitudes of flow reductions predicted  
21 for Alternative 1A and 2A, juvenile survival would decrease less than 0.5%, well under the criteria of  
22 a 5% change in Delta migration survival. The five intake structures would attract predators and  
23 would displace about 22 acres of aquatic habitat.

24 *Adults*

25 Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10%  
26 difference) to Existing Conditions for nearly all months of the year. The proportion of flows would  
27 decrease slightly in March by 11% during the post-peak period, but increase in September by 18%  
28 during the pre-peak.

29 ***San Joaquin River***

30 *Juveniles*

31 The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of  
32 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.  
33 There no flow changes associated with the Alternatives. Alternative 2A would have no effect on  
34 steelhead migration success through the Delta.

35 *Adults*

36 Little information apparently currently exists as to the importance of Plan Area flows on the straying  
37 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon

1 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of  
2 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including  
3 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region  
4 steelhead adults as well.

5 The percentage of water at Collinsville that originated from the San Joaquin River during the fall-run  
6 migration period (September to December) is small, typically 0.1% to less than 3% under Existing  
7 Conditions. Alternative 2A operations conditions would incrementally increase olfactory cues  
8 associated with the San Joaquin River, which would benefit adult steelhead migrating to the San  
9 Joaquin River.

## 10 **Summary of CEQA Conclusion**

11 Collectively, these results indicate that there would be significant impacts of Alternative 2A on  
12 steelhead migration conditions because the alternative could substantially interfere with the  
13 movement of fish. Alternative 2A would have significant impacts on migration in the American,  
14 Feather, Stanislaus, San Joaquin, and Mokelumne Rivers due to flow reductions and elevated water  
15 temperatures. These effects on flows and temperatures would reduce the ability for steelhead  
16 juveniles, adult, and kelts to migrate successfully. Through-Delta juvenile steelhead survival would  
17 be reduced under Alternative 2A. Potential predation losses would increase at the five intake  
18 structures, ranging hypothetically from <2% to 19% of juveniles that reach the Delta. Approximately  
19 22 acres of habitat would be removed for new intake structures.

20 With respect to the NDD intakes, implementation of CM6 and CM15 and Mitigation Measures AQUA-  
21 60a through AQUA-60c would address these impacts, but are not anticipated to reduce them to a  
22 level considered less than significant. Although implementation of *CM6 Channel Margin*  
23 *Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be  
24 located near the intakes and therefore would not fully compensate for the lost habitat. Additionally,  
25 implementation of this measure would not fully address predation losses. *CM15 Localized Reduction*  
26 *of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness  
27 such that it is considered to have no demonstrable effect. Conservation measures that address  
28 habitat and predation losses, therefore, would potentially minimize impacts to some extent but not  
29 to a less than significant level. Consequently, as a result of these changes in migration conditions,  
30 this impact is significant and unavoidable.

31 Applicable conservation measures are briefly described below and full descriptions are found in  
32 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized  
33 Reduction of Predatory Fishes (Predator Control) (CM15).

34 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
35 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
36 habitats on the waterside side of levees along channels that provide rearing and outmigration  
37 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side  
38 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length  
39 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10  
40 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be  
41 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel  
42 margin enhancement would be performed only along channels that provide rearing and  
43 outmigration habitat for juvenile salmonids. These include channels that are protected by

1 federal project levees—including the Sacramento River between Freeport and Walnut Grove  
2 among several others.

3 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
4 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
5 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to  
6 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are  
7 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.  
8 Therefore, this conservation measure is not intended to entirely remove predators at any  
9 location, or substantially alter the abundance of predators at the scale of the Delta system. This  
10 conservation measure would also not remove piscivorous birds. Because of uncertainties  
11 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot  
12 projects and research actions coupled with an adaptive management and monitoring program to  
13 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to  
14 occupy vacated areas; therefore, removal activities would need to be continuous during periods  
15 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

16 In addition to the conservation measures, the mitigation measures identified below would provide  
17 an adaptive management process, that may be conducted as a part of the Adaptive Management and  
18 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing  
19 impacts and developing appropriate minimization measures. However, this would not necessarily  
20 result in a less than significant determination.

21 **Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional**  
22 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**  
23 **Reduce Impacts to Migration Conditions**

24 Although analysis conducted as part of the EIR/EIS determined that Alternative 2A would have  
25 significant and unavoidable adverse effects on migration habitat, this conclusion was based on  
26 the best available scientific information at the time and may prove to have been over- or  
27 understated. Upon the commencement of operations of CM1 and continuing through the life of  
28 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine  
29 whether such effects would be as extensive as concluded at the time of preparation of this  
30 document and to determine any potentially feasible means of reducing the severity of such  
31 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
32 consistent with the operational framework for Alternative 2A.

33 The development and implementation of any mitigation actions shall be focused on those  
34 incremental effects attributable to implementation of Alternative 2A operations only.  
35 Development of mitigation actions for the incremental impact on migration habitat attributable  
36 to climate change/sea level rise are not required because these changed conditions would occur  
37 with or without implementation of Alternative 2A.

38 **Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts**  
39 **on Steelhead Migration Conditions Following Initial Operations of CM1**

40 Following commencement of initial operations of CM1 and continuing through the life of the  
41 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
42 modified operations could reduce impacts to migration habitat under Alternative 2A. The

1 analysis required under this measure may be conducted as a part of the Adaptive Management  
2 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

3 **Mitigation Measure AQUA-96c: Consult with USFWS, and CDFW to Identify and Implement**  
4 **Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions**  
5 **Consistent with CM1**

6 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead  
7 habitat, the BDCP proponents will consult with FWS and the Department of Fish and Wildlife to  
8 identify and implement any feasible operational means to minimize effects on migration habitat.  
9 Any such action will be developed in conjunction with the ongoing monitoring and evaluation of  
10 habitat conditions required by Mitigation Measure AQUA-96a.

11 If feasible means are identified to reduce impacts on migration habitat consistent with the  
12 overall operational framework of Alternative 2A without causing new significant adverse  
13 impacts on other covered species, such means shall be implemented. If sufficient operational  
14 flexibility to reduce effects on steelhead habitat is not feasible under Alternative 2A operations,  
15 achieving further impact reduction pursuant to this mitigation measure would not be feasible  
16 under this Alternative, and the impact on steelhead would remain significant and unavoidable.

17 **Restoration Measures (CM2, CM4–CM7, and CM10)**

18 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
19 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
20 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of  
21 restoration measures described for steelhead under Alternative 1A (Impact AQUA-97 through  
22 AQUA-99) also appropriately characterize effects under Alternative 2A.

23 The following impacts are those presented under Alternative 1A that are identical for Alternative  
24 2A.

25 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

26 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

27 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

28 **NEPA Effects:** All three of these impact mechanisms have been determined to result in no adverse  
29 effects on steelhead for NEPA purposes. Specifically for AQUA-98, the effects of contaminants on  
30 steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The  
31 effects of methylmercury on steelhead are uncertain.

32 **CEQA Conclusion:** All three of these impact mechanisms would be considered less than significant  
33 on steelhead, for the reasons identified for Alternative 1A, and no mitigation is required.

34 **Other Conservation Measures (CM12–CM19 and CM21)**

35 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
36 differences in other conservation-related fish effects are anticipated anywhere in the affected  
37 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish

1 effects of other conservation measures described for steelhead under Alternative 1A (Impact AQUA-  
2 100 through AQUA-108) also appropriately characterize effects under Alternative 2A.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative  
4 2A.

5 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

6 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

7 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

8 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

9 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

10 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

11 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

12 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

13 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
14 **(CM21)**

15 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
16 adverse effect, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for  
17 Alternative 1A.

18 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
19 less than significant, or beneficial on steelhead, for the reasons identified for Alternative 1A, and no  
20 mitigation is required.

## 21 **Sacramento Splittail**

### 22 **Construction and Maintenance of CM1**

#### 23 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento** 24 **Splittail**

25 The potential effects of construction of the water conveyance facilities on Sacramento splittail would  
26 be similar to those described for Alternative 1A (Impact AQUA-109) except that Alternative 2A could  
27 potentially include two different intakes than under Alternative 1A. This would convert about  
28 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
29 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
30 feet of shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact  
31 AQUA-109, the effect would not be adverse for Sacramento splittail.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-109, the impact of the construction  
2 of water conveyance facilities on Sacramento splittail would be less than significant except for  
3 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
4 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

11 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
12 **Splittail**

13 The potential effects of the maintenance of water conveyance facilities under Alternative 2A would  
14 be the same as those described for Alternative 1A (see Impact AQUA-110). As concluded in  
15 Alternative 1A, Impact AQUA-110, the effect would not be adverse for Sacramento splittail.

16 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance  
17 of water conveyance facilities on Sacramento splittail would be less than significant and no  
18 mitigation is required.

19 **Water Operations of CM1**

20 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

21 ***Water Exports from SWP/CVP South Delta Facilities***

22 Under Alternative 2A, total entrainment of juvenile splittail at the south Delta facilities (estimated  
23 from Yolo Bypass inundation) averaged across all years would be expected to be 211% greater than  
24 NAA, and 1,315% greater in above normal years (Table 11-2A-57). However, this increase is entirely  
25 due to the substantial increase in juvenile splittail abundance resulting from additional floodplain  
26 habitat in wetter water year types. The per capita rate of splittail entrainment averaged across all  
27 years would be reduced 47% for juveniles (Table 11-2A-58) and reduced 68% for adults (Table 11-  
28 2A-59). Per capita entrainment would be most reduced in wet water years (61% reduction for  
29 juveniles, 91% reduction for adults) and least reduced in below normal water years (26%  
30 reduction) for juveniles and critical water years (20%) for adults. The decrease in per capita  
31 entrainment of splittail is due to reductions in south Delta water exports during the main May–June  
32 entrainment period.

1 **Table 11-2A-57. Juvenile Sacramento Splittail Entrainment Index<sup>a</sup> (Yolo Bypass Days of Inundation**  
 2 **Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for**  
 3 **Alternative 2A**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	2,606,381 (272%)	2,419,722 (211%)
Above Normal	479,962 (1,049%)	488,567 (1,315%)
Below Normal	12,772 (374%)	13,204 (442%)
Dry	1,312 (46%)	1,657 (65%)
Critical	-267 (-18%)	184 (17%)
All Years	899,081 (288%)	841,372 (227%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data, estimated from Yolo Bypass Inundation Method.

4  
 5 **Table 11-2A-58. Juvenile Sacramento Splittail Entrainment Index<sup>a</sup> (per Capita Method) at the**  
 6 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 2A**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-1,353,127 (-68%)	-1,028,808 (-61%)
Above Normal	-72,034 (-54%)	-54,202 (-47%)
Below Normal	-2,786 (-28%)	-2,468 (-26%)
Dry	-989 (-49%)	-499 (-33%)
Critical	-566 (-42%)	-308 (-29%)
All Years	-309,989 (-57%)	-208,441 (-47%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

7  
 8 **Table 11-2A-59. Adult Sacramento Splittail Entrainment Index<sup>a</sup> (Salvage Density Method) at the**  
 9 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 2A**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-3,600 (-91%)	-3,736 (-91%)
Above Normal	-4,092 (-85%)	-4,108 (-85%)
Below Normal	-1,770 (-52%)	-1,505 (-48%)
Dry	-818 (-33%)	-653 (-29%)
Critical	-861 (-26%)	-639 (-20%)
All Years	-2,390 (-69%)	-2,312 (-68%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data. Average (December–March).

10

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 The impact from entrainment of splittail to the proposed SWP/CVP north Delta intakes is the same  
3 as Impact AQUA-111 under Alternative 1A. Splittail larvae would be vulnerable to entrainment to  
4 these intakes, although little is known about their densities around this vicinity. Entrainment and  
5 impingement monitoring would be implemented to determine the extent to which splittail larvae  
6 are present.

7 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

8 The effect of implementing dual conveyance for the NBA with an alternative Sacramento River  
9 intake would be the same as described under Alternative 1A (Impact AQUA-111). Reduced pumping  
10 from Barker Slough could reduce entrainment losses of larval splittail produced in the Yolo Bypass.  
11 There would be potential for increased predation and impingement risk associated with the  
12 alternative intake, which would be screened to exclude splittail greater than 10 mm.

13 **Predation Associated with Entrainment**

14 As described for Alternative 1A (Impact AQUA-111), Sacramento splittail predation loss at the south  
15 Delta facilities is assumed to be proportional to entrainment loss. Per capita splittail entrainment at  
16 the south Delta would be reduced under Alternative 2A by 47% compared to NAA; predation losses  
17 would be expected to decrease at a similar proportion.

18 The impact from potential predation associated with the north Delta intake structures (5 intakes)  
19 would be the same as described for Alternative 1A (Impact AQUA-111). Potential predation at the  
20 north Delta would be partially offset by reduced predation loss at the SWP/CVP south Delta intakes  
21 and the increased production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries  
22 Enhancement). Further, the fishery agencies concluded that predation was not a factor currently  
23 limiting splittail abundance.

24 **NEPA Effects:** The effect of Alternative 2A on entrainment and predation loss would not be adverse,  
25 because while predation loss of splittail would be increased, it would be offset by the substantial  
26 reductions in per capita entrainment risk at the south Delta facilities and the increased production  
27 of juvenile splittail under CM2 (Yolo Bypass Fisheries Enhancement).

28 **CEQA Conclusion:** Operational activities associated with decreased water exports from SWP/CVP  
29 south Delta facilities would result in an overall decrease in the proportion of the splittail population  
30 entrained. However, operational activities associated with reduced south Delta water exports would  
31 result in an overall decrease in the proportion of splittail population entrained for all water year  
32 types. Estimated per capita juvenile entrainment to the south Delta facilities would be reduced 57%  
33 while adult per capita entrainment would be reduced 69% relative to Existing Conditions. At the  
34 proposed north Delta facilities, Sacramento splittail would be subject to larval entrainment and  
35 impingement, and predation losses at the same levels described for Alternative 1A (Impact AQUA-  
36 111).

37 In conclusion, the impact from entrainment and predation loss would be less than significant,  
38 because increase in predation losses at the north Delta under Alternative 2A would be offset by the  
39 substantial reduction in south Delta entrainment losses and the increased production of juvenile  
40 splittail from CM2 actions. No mitigation would be required.

1 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Sacramento Splittail**

3 In general, Alternative 2A would have beneficial effects on splittail spawning habitat relative to NAA  
4 by increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be  
5 negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins  
6 Slough and the Feather River, and negligible effects on water temperatures in the Feather River,  
7 relative to NAA. There would be beneficial effects on spawning conditions in channel margin and  
8 side-channel habitats from increases in mean monthly flow during the spawning period in both the  
9 Sacramento River and the Feather River. There would also be a beneficial effect from reductions in  
10 the occurrence of critical high water temperatures in the Feather River in wetter water year types.

11 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream  
12 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning  
13 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not  
14 inundated, spawning in side channels and channel margins would be much more critical.

15 ***Floodplain Habitat***

16 Effects of Alternative 2A on floodplain spawning habitat were evaluated for Yolo Bypass. Increased  
17 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the  
18 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects  
19 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m  
20 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored  
21 because flow velocity was generally very low throughout the modeled area for most conditions, with  
22 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a  
23 reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

24 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo  
25 Bypass inundation events compared to NAA, especially for dry and critical year types; the changes  
26 are attributable to the influence of the Fremont Weir notch at lower flows. Only the inundation  
27 events lasting more than 30 days are considered biologically beneficial to splittail, so are the focus of  
28 the analyses provided here. A2A\_LL1 compared to NAA for the drier type years (below normal, dry,  
29 and critical), results in no change or an increase in frequency for events greater than 30 days  
30 compared to NAA over the 82-year simulation period (Figure 11-2A-4, Table 11-2A-60). For below  
31 normal years, Alternative 2A would result in occurrence of 2 inundation events  $\geq 70$  days, compared  
32 to 0 such events for NAA. For dry and critical years, project-related increases are for 30–49 day  
33 duration events as there are no events of longer duration. These results indicate that overall project-  
34 related effects on occurrence of various duration inundation events would be beneficial for splittail  
35 spawning by creating better spawning habitat conditions.

1 **Table 11-2A-60. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**  
 2 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**  
 3 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
<b>30-49 Days</b>		
Wet	-5	-3
Above Normal	0	0
Below Normal	4	4
Dry	1	1
Critical	1	1
<b>50-69 Days</b>		
Wet	-5	-5
Above Normal	1	1
Below Normal	0	0
Dry	0	0
Critical	0	0
<b>≥70 Days</b>		
Wet	8	7
Above Normal	1	1
Below Normal	2	2
Dry	0	0
Critical	0	0

4  
 5 There would be increases in area of suitable splittail habitat in Yolo Bypass under A2A\_LLT ranging  
 6 from 5 to 949 acres relative to NAA. Areas under A2A\_LLT would be 56%, 60%, and 196% greater  
 7 than areas under NAA in wet, above normal, and below normal water years, respectively (Table 11-  
 8 2A-61). There would also be increases in area under A2A\_LLT in dry and critical years relative to  
 9 NAA, but they would be minimal (14 and 5 acres, respectively). These results indicate that increases  
 10 in inundated acreage in each water year type would result in increased habitat and have a beneficial  
 11 effect on splittail spawning.

12 **Table 11-2A-61. Increase in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass**  
 13 **from Existing Biological Conditions to Alternative 2A by Water Year Type from 15 2-D and Daily**  
 14 **CALSIM II Modeling Runs**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	1,088 (70%)	949 (56%)
Above Normal	698 (61%)	690 (60%)
Below Normal	245 (187%)	249 (196%)
Dry	14 (NA)	14 (NA)
Critical	5 (NA)	5 (NA)

NA = percent differences could not be computed because no splittail weighted habitat occurred in the bypass for NAA and EXISTING CONDITIONS in those years (dividing by 0).

15

1 A potential adverse effect of Alternative 2A that is not included in the modeling is reduced  
2 inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The  
3 Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted  
4 from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers.  
5 comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened  
6 notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir.  
7 A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont  
8 Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although  
9 understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In  
10 any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of  
11 inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the  
12 river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass  
13 inundation is poorly known. Despite this uncertainty, it is evident that *CM2 Yolo Bypass Fisheries*  
14 *Enhancement* has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on  
15 splittail production due to effects on Sutter Bypass inundation. Splittail use the Sutter Bypass for  
16 spawning and rearing as they do the Yolo Bypass.

#### 17 ***Channel Margin and Side-Channel Habitat***

18 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel  
19 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,  
20 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are  
21 affected by changes in flow because greater flows cause more flooding, thereby increasing  
22 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially  
23 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are  
24 expected to be most important to the splittail population because in years of high-flows, when most  
25 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively  
26 little production.

27 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions  
28 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the  
29 Sacramento River for the time-frame February through June. These are the most important months  
30 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from  
31 the side-channel habitats during May and June if conditions become unfavorable.

32 Differences between model scenarios for monthly average flows during February through June by  
33 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather  
34 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 For the Sacramento River at Wilkins Slough, flows during February through April under A2A\_LLT  
36 would be similar to flows under NAA. During May and June, flows under A2A\_LLT would be up to  
37 26% greater than flows under NAA, resulting in a beneficial effect on rearing conditions. Water  
38 temperature in the Sacramento River under Alternative 2A would not differ from results for  
39 Alternative 1A, which indicate that these results indicate that there would be some increases in flow  
40 (up to 26%) would have beneficial effects on splittail rearing conditions in the Sacramento River.

1 For the Feather River at the confluence, flows during February and March under A2A\_LL1T would be  
2 similar to flows under NAA. During April through June, flows under A2A\_LL1T would be up to 73%  
3 greater than flows under NAA, resulting in a beneficial effect on spawning conditions.

4 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather  
5 River at the confluence with the Sacramento River, respectively were used to investigate the  
6 potential effects of Alternative 2A on the suitability of water temperatures for splittail spawning and  
7 egg incubation. A range of 45°F to 75°F was selected for evaluating the suitable range for splittail  
8 spawning and egg incubation.

9 There would be no biologically meaningful difference (>5% absolute scale) between NAA and  
10 Alternative 2A in the frequency of water temperatures in the Sacramento and Feather Rivers being  
11 within the suitable 45°F to 75°F regardless of water year type.

12 Overall, Alternative 2A would have negligible or beneficial effects on upstream spawning and  
13 rearing conditions in the upper Sacramento and Feather rivers.

1 **Table 11-2A-62. Difference (Percent Difference) in Percent of Days or Months<sup>a</sup> during February to**  
 2 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**  
 3 **Hamilton City and Feather River at the Confluence with the Sacramento River<sup>b</sup>**

	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
<b>Sacramento River at Hamilton City</b>		
<i>Temperatures below 45°F</i>		
Wet	-4 (-86%)	0 (0%)
Above Normal	-4 (-86%)	0 (0%)
Below Normal	-4 (-79%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-1 (-49%)	1 (NA)
All	-3 (-76%)	0 (0%)
<i>Temperatures above 75°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<b>Feather River at Sacramento River Confluence</b>		
<i>Temperatures below 45°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<i>Temperatures above 75°F</i>		
Wet	3 (NA)	-2 (-43%)
Above Normal	0 (NA)	-9 (-100%)
Below Normal	6 (NA)	-6 (-50%)
Dry	13 (300%)	0 (0%)
Critical	13 (800%)	0 (0%)
All	7 (560%)	-3 (-27%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Days were used in the Sacramento River and months were used in the Feather River.

<sup>b</sup> Based on the modeling period of 1922 to 2003.

4

5 **Stranding Potential**

6 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,  
 7 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and  
 8 historical data to evaluate possible stranding effects, the following provides a narrative summary of  
 9 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,

1 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the  
 2 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial  
 3 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.  
 4 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding  
 5 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while  
 6 keeping water away from other areas to reduce stranding in isolated ponds. Actions under  
 7 Alternative 2A to increase the frequency of Yolo Bypass inundation would increase the frequency of  
 8 potential stranding events. For splittail, an increase in inundation frequency would also increase the  
 9 production of Sacramento splittail in the bypass. While total stranding losses may be greater under  
 10 Alternative 2A than under NAA, the total number of splittail would be expected to be greater under  
 11 Alternative 2A.

12 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement  
 13 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands  
 14 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may  
 15 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the  
 16 potential improvements in habitat capacity outweighed the potential stranding problems that may  
 17 exist in some years. Overall, these effects are not adverse.

18 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
 19 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
 20 of egg mortality. The effects of Alternative 2A on splittail spawning habitat are primarily beneficial.  
 21 There would be benefits due to increased inundation in the Yolo Bypass that would increase the  
 22 quantity and quality of spawning habitat there, and benefits to channel margin and side-channel  
 23 habitat in the Sacramento River and Feather River from increases in mean monthly flow and  
 24 decreases in high water temperatures during the spawning period.

25 **CEQA Conclusion:** In general, Alternative 2A would have beneficial effects on splittail spawning  
 26 habitat relative to the Existing Conditions by increasing the quantity of spawning habitat in the Yolo  
 27 Bypass through increased acreage subjected to periodic inundation. There would be negligible  
 28 effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and  
 29 the Feather River, with some beneficial effect due to increases in mean monthly flow for some  
 30 months and water year types during the spawning period. There would be negative effects on water  
 31 temperatures in the Feather River relative to the Existing Conditions, but the benefits due to  
 32 increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water  
 33 temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to  
 34 splittail than channel margin habitat in the Feather River, as evidenced by the large amount of  
 35 spawning activity when inundated.

### 36 **Floodplain Habitat**

37 Comparisons of splittail weighted habitat area for Alternative 2A and Existing Conditions show  
 38 relatively little difference between the two scenarios in longer-duration inundation events, with no  
 39 change or relatively small increases or decreases for Alternative 2A compared to Existing Conditions  
 40 (Table 11-2A-60 and Figure 11-2A-4). However, Alternative 2A would result in increased acreage of  
 41 suitable spawning habitat compared to Existing Conditions (Table 11-2A-61), with increases of  
 42 between 5 and 1,088 acres of suitable spawning habitat depending on water year type. Increased  
 43 areas for wet, above normal, and below normal water years are predicted to be 70%, 61%, and  
 44 187%, respectively, for Alternative 2A. Comparisons for dry and critical water years indicate

1 project-related increases of 14 and 5 acres of suitable spawning habitat, respectively, compared to 0  
2 acres for Existing Conditions. These results indicate that Alternative 2A would have beneficial effects  
3 on splittail habitat through increasing spawning habitats.

#### 4 ***Channel Margin and Side-Channel Habitat***

5 Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through  
6 June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results*  
7 *utilized in the Fish Analysis*). Results indicate that Alternative 2A would have negligible effects (<5%)  
8 on channel margin and side-channel habitats during February through April with the exception of  
9 one small decrease in flow (-6%) during March in below normal years. Flows under A2A\_LLT would  
10 generally be up to 42% greater than flows under Existing Conditions during May and June. These  
11 results indicate that effects of Alternative 2A on flows would generally have beneficial effects on  
12 splittail spawning and rearing conditions in the upper Sacramento River.

13 Flows in the Feather River at the confluence with the Sacramento River were evaluated during  
14 February through June. Flows during this period would generally be similar between Existing  
15 Conditions and A2A\_LLT with some exceptions. Based on the relatively small magnitude and  
16 infrequent nature of the flow differences, the effects of Alternative 2A on flow would not have  
17 biologically meaningful effects on splittail rearing conditions in the Feather River.

18 There would generally be no biologically meaningful difference (>5% absolute scale) between  
19 Existing Conditions and Alternative 2A in the frequency of water temperatures in the Sacramento  
20 and Feather Rivers being within the suitable 45°F to 75°F, except in dry and critical water years  
21 (13% greater) for the 75°F threshold in the Feather River.

22 There would be no difference between Existing Conditions and A2A\_LLT in the number of years in  
23 which temperatures would be below 45°F (Table 11-2A-62) because there are never any months  
24 with temperatures below 45°F under any scenario. Exceedances above 75°F under A2A\_LLT would  
25 occur more often than under Existing Conditions in all water years except above normal. These  
26 results indicate that Alternative 2A would have negative temperature effects on splittail spawning in  
27 the Feather River and would provide benefits in wetter water year types.

#### 28 ***Stranding Potential***

29 Because there would be little difference in flow conditions between Alternative 2A and Existing  
30 Conditions, the project would not have biologically meaningful effects on stranding potential.

#### 31 **Summary of CEQA Conclusion**

32 Overall, these results indicate that the impact is less than significant because it would not  
33 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
34 of egg mortality. No mitigation is necessary.

#### 35 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

36 ***NEPA Effects:*** In general, Alternative 2A would have beneficial effects on splittail rearing habitat  
37 relative to NAA based on an increase in the quantity and quality of rearing habitat in the Yolo  
38 Bypass, beneficial effects on rearing conditions in channel margin and side-channel habitats in the  
39 Sacramento River and the Feather River, and reductions in the occurrence of critical high water  
40 temperatures in the Feather River in wetter water year types.

1 Sacramento splittail rear in floodplain and main-channel environments; the analyses of splittail  
2 weighted habitat area in Yolo Bypass and effects of flow conditions on channel margin and side-  
3 channel habitats provided in the previous impact, Impact AQUA-112, apply to rearing as well as  
4 spawning habitat for splittail. As concluded above, the effect is not adverse because it would not  
5 substantially reduce suitable rearing habitat or substantially reduce the number of fish as a result of  
6 juvenile mortality. Effects of Alternative 2A on flow would have beneficial effects on the availability  
7 of channel margin and main-channel habitat through increases in mean monthly flow for some  
8 months and water year types during the rearing period. Increased flows into Yolo Bypass may  
9 reduce flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create  
10 habitat in the Yolo Bypass that would have a beneficial effect on rearing conditions.

11 **CEQA Conclusion:** In general, Alternative 2A would have beneficial effects on splittail rearing habitat  
12 relative to the Existing Conditions by increasing the quantity of rearing habitat in the Yolo Bypass,  
13 and increases in mean monthly flow for some months and water year types in the Sacramento River  
14 and the Feather River.

15 Project effects on splittail rearing habitat are the same as described for spawning habitat in the  
16 previous impact discussion, Impact AQUA-112. As concluded above, the impact is not significant  
17 because it would not substantially reduce suitable rearing habitat or substantially reduce the  
18 number of fish as a result of juvenile mortality and no mitigation is necessary. Effects of Alternative  
19 2A on flow would not have negative effects on the availability of channel margin and main-channel  
20 habitat, and would have a beneficial effect through increases in mean monthly flow for some months  
21 and water year types during the rearing period. Increased flows into Yolo Bypass may reduce  
22 flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create habitat in  
23 the Yolo Bypass that would have a beneficial effect on rearing conditions. Benefits to rearing habitat  
24 availability in the Yolo Bypass would outweigh negative effects of increased exposures to water  
25 temperatures above the upper threshold of 75°F in the Feather River in drier water year types.

## 26 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento** 27 **Splittail**

### 28 **Upstream of the Delta**

29 In general, effects of Alternative 2A would not affect splittail migration conditions in the Sacramento  
30 River or the Feather River relative to NAA based on negligible or beneficial effects on mean monthly  
31 flow during the migration period and negligible or beneficial effects on water temperatures in the  
32 Feather River.

33 The effects of Alternative 2A on splittail migration conditions would be the same as described for  
34 channel margin and side-channel habitats in the Sacramento River and Feather River for Impact  
35 AQUA-112 above. There would be benefits to channel margin and side-channel habitat in both  
36 locations from increases in mean monthly flow and decreases in high water temperatures compared  
37 to baseline conditions.

### 38 **Through-Delta**

39 Alternative 2A is expected to reduce OMR reverse flows during the period of juvenile splittail  
40 migration through the Delta. OMR flows are greatly improved in June and July compared to baseline  
41 conditions across all water years. While flows are decreased slightly in all water year types except

1 wet in May, OMR flows averaged across all water years are still positive and flowing towards the San  
2 Francisco estuary.

3 **NEPA Effects:** The effect of Alternative 2A is not adverse because it would not substantially reduce  
4 or degrade migration habitat or substantially reduce the number of fish as a result of mortality.  
5 Similarly, because OMR flows are overall improved, the effect of Alternative 2A on through-Delta  
6 migration conditions for Sacramento splittail would be beneficial.

7 **CEQA Conclusion:**

#### 8 **Upstream of the Delta**

9 In general, effects of Alternative 2A would not affect splittail migration conditions in the Sacramento  
10 River relative to the Existing Conditions, but would reduce the suitability of channel conditions for  
11 migration in the Feather River due to increased exposure to critical water temperatures. However,  
12 splittail spawning in the Feather River is not as important as in Yolo Bypass, and therefore, net  
13 effects from Alternative 2A on migration conditions in the Feather River would be negligible.

14 Effects of Alternative 2A on splittail migration conditions are the same as described for channel  
15 margin and side-channel habitats in Impact AQUA-112. As concluded above, the impact is not  
16 significant because it would not substantially reduce suitable migration habitat or substantially  
17 reduce the number of fish as a result of mortality and no mitigation is necessary. Effects of  
18 Alternative 2A on flow would not have negative effects on the availability of channel margin and  
19 main-channel habitat, and would have a beneficial effect through increases in mean monthly flow for  
20 some months and water year types during the migration period. Benefits to habitat availability in  
21 the Yolo Bypass would outweigh negative effects of increased exposures to water temperatures  
22 above the upper threshold of 75°F in the Feather River in drier water year types.

#### 23 **Through-Delta**

24 As described above, average OMR flows under Alternative 2A are expected to improve during the  
25 juvenile splittail migration through the Delta, especially during the summer months. In dry and  
26 below-normal water years in May, the reverse OMR flows would be increased under Alternative 2A  
27 compared to Existing Conditions, however monthly average OMR flows would be still be slightly  
28 improved in May compared to Existing Conditions. In addition, the periods of increased reverse  
29 flows in May would remain within the NMFS and USFWS BiOp requirements, thus the changes are  
30 expected to have a less-than-significant impact. Therefore, the impact on splittail migration survival  
31 would be beneficial because of the overall improvement in OMR flows.

#### 32 **Summary of CEQA Conclusion**

33 Overall, Alternative 2A would not affect splittail migration conditions in the Sacramento River  
34 relative to the Existing Conditions, the impact is not significant because it would not substantially  
35 reduce suitable migration habitat or substantially reduce the number of fish as a result of mortality  
36 and no mitigation is necessary. Similarly, Alternative 2A is expected to reduce OMR reverse flows  
37 during the period of juvenile splittail migration through the Delta, resulting in greatly improved  
38 conditions in June and July compared to baseline conditions across all water years. Therefore the  
39 impact on splittail migration survival is less than significant. No mitigation is required.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
3 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
4 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of  
5 restoration measures described for Sacramento splittail under Alternative 1A (Impact AQUA-115  
6 through AQUA-117) also appropriately characterize effects under Alternative 2A.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative  
8 2A.

9 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

10 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**  
11 **Sacramento Splittail**

12 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

13 *NEPA Effects:* All three of these impact mechanisms have been determined to result in no adverse  
14 effects on Sacramento splittail for NEPA purposes. Specifically for AQUA-116, the effects of  
15 contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides  
16 would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

17 *CEQA Conclusion:* All three of these impact mechanisms would be considered less than significant  
18 on Sacramento splittail, for the reasons identified for Alternative 1A, and no mitigation is required.

19 **Other Conservation Measures (CM12–CM19 and CM21)**

20 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
21 differences in other conservation-related fish effects are anticipated anywhere in the affected  
22 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish  
23 effects of other conservation measures described for Sacramento splittail under Alternative 1A  
24 (Impact AQUA-118 through AQUA-126) also appropriately characterize effects under Alternative  
25 2A.

26 The following impacts are those presented under Alternative 1A that are identical for Alternative  
27 2A.

28 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

29 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**  
30 **Splittail (CM13)**

31 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
32 **(CM14)**

33 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
34 **(CM15)**

35 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

1 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

2 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

3 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

4 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**  
5 **Splittail (CM21)**

6 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
7 adverse effect, or beneficial effects on Sacramento splittail for NEPA purposes, for the reasons  
8 identified for Alternative 1A.

9 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
10 less than significant, or beneficial on Sacramento splittail, for the reasons identified for Alternative  
11 1A, and no mitigation is required.

12 **Green Sturgeon**

13 **Construction and Maintenance of CM1**

14 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

15 The potential effects of construction of the water conveyance facilities on green sturgeon would be  
16 similar to those described for Alternative 1A (Impact AQUA-127) except that Alternative 2A could  
17 potentially include two different intakes than under Alternative 1A. This would convert about  
18 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
19 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
20 feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
21 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
22 of contaminated sediments would be similar to Alternative 1A and the same environmental  
23 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
24 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
25 effects.

26 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and  
27 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
28 not be adverse for green sturgeon.

29 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-127, the impact of the construction  
30 of water conveyance facilities on green sturgeon would be less than significant except for  
31 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
32 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

33 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
34 **of Pile Driving and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

4           **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

5           **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
6           Alternative 2A would be the same as those described for Alternative 1A (see Impact AQUA-128). As  
7           concluded in Alternative 1A, Impact AQUA-128, the effect would not be adverse for green sturgeon.

8           **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-128, the impact of the maintenance  
9           of water conveyance facilities on green sturgeon would be less than significant and no mitigation is  
10          required.

11          **Water Operations of CM1**

12          **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

13          ***Water Exports from SWP/CVP South Delta Facilities***

14          Alternative 2A is expected to substantially reduce overall entrainment of juvenile green sturgeon at  
15          the south Delta export facilities. Average annual loss of juvenile green sturgeon, as estimated by the  
16          salvage density method, would be approximately 58 fish for the combined SWP and CVP south Delta  
17          facilities (Table 11-2A-63; A2A\_LLTT). Losses would be slightly greater in wetter water year types  
18          (32 fish) than in drier years (26 fish). Losses would decrease 60–64% for Alternative 2A as  
19          compared to NAA. Entrainment reductions would be greater in wetter years (69–71% decrease)  
20          compared to Existing Conditions.

21          ***Water Exports from SWP/CVP North Delta Intake Facilities***

22          The overall potential entrainment effects of operating the new north Delta intakes under Alternative  
23          2A would be the same as described for Impact AQUA-129 under Alternative 1A. The intakes would  
24          have screens to avoid or reduce entrainment; there would be no adverse effect.

25          ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

26          The overall potential entrainment effects of operating the dual conveyance of the North Bay  
27          Aqueduct under Alternative 2A would be the same as described for Impact AQUA-129 under  
28          Alternative 1A. The intakes would have screens to avoid or reduce entrainment; there would be no  
29          adverse effect.

30          ***Predation Associated with Entrainment***

31          Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to  
32          entrainment loss. Sturgeon develop bony scutes at a young age which reduces their predation  
33          vulnerability. The total reduction of juvenile green sturgeon entrainment, and hence predation loss,  
34          would change minimally between Alternative 2A and NAA (88 fish). Based on their early  
35          development of scutes and rapid growth rates, the number of juvenile green sturgeon lost to  
36          predation at the south Delta facilities would change negligibly between Alternative 2A and NAA. The

1 impact and conclusion for predation risk associated with NPB structures and the north Delta intakes  
2 would be the same as described for Alternative 1A (Impact AQUA-3 for green sturgeon).

3 **NEPA Effects:** The effect on entrainment and predation losses under Alternative 2A would not be  
4 adverse, because green sturgeon grow rapidly and develop bony scutes early in their development  
5 which reduces their predation risk.

6 **CEQA Conclusion:** As described above, annual entrainment losses of juvenile green sturgeon across  
7 all years would decrease 65% under Alternative 2A (A2A\_LLT) (58 fish) relative to Existing  
8 Conditions (166 fish) (Table 11-2A-63). impacts of water operations on green sturgeon would be  
9 beneficial due to an overall reduction in entrainment and no mitigation would be required.

10 **Table 11-2A-63. Juvenile Green Sturgeon Annual Entrainment Index<sup>a</sup> at the SWP and CVP Salvage**  
11 **Facilities for Alternative 2A**

Water Year <sup>b</sup>	Entrainment Index			Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS	NAA	A2A_LLT	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet and Above Normal	116	104	32	-84 (-72%)	-72 (-69%)
Below Normal, Dry, and Critical	50	42	26	-24 (-48%)	-16 (-38%)
All Years	166	146	58	-108 (-65%)	-88 (-60%)

<sup>a</sup> Estimated annual number of fish lost.

<sup>b</sup> Sacramento Valley water year-types.

12  
13 The impact of predation associated with entrainment would be the same as described immediately  
14 above because the rapid growth and development of bony scutes reduces the predation risk for  
15 juvenile green sturgeon. Since few juvenile green sturgeon are entrained at the south Delta,  
16 reductions in entrainment (65% reduction compared to Existing Conditions, representing 108 fish)  
17 under Alternative 2A would have little effect on entrainment-related predation loss. Overall, the  
18 impact would be less than significant, because there would be little change in predation loss under  
19 Alternative 2A.

20 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
21 **Green Sturgeon**

22 In general, Alternative 2A would not affect spawning and egg incubation habitat for green sturgeon  
23 relative to NAA.

24 **Sacramento River**

25 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
26 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows  
27 can reduce the instream area available for spawning and egg incubation. Flows under A2A\_LLT  
28 would always be similar to or greater than flows under NAA during March through July (Appendix  
29 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During July flows would be lower than  
30 under NAA up to 6%. Also flows can be lower or higher in individual months of individual years

1 These results indicate that there would be very few reductions in flows in the Sacramento River  
2 under Alternative 2A.

3 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
4 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 NAA and Alternative 2A in any month or water year type throughout the period.

8 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was  
9 determined for each month (May through September) and year of the 82-year modeling period  
10 (Table 11-2A-10). The combination of number of days and degrees above the 63°F threshold were  
11 further assigned a “level of concern” as defined in Table 11-2A-11. Differences between baselines  
12 and Alternative 2A in the highest level of concern across all months and all 82 modeled years are  
13 presented in Table 11-2A-64. There would be no difference in levels of concern between NAA and  
14 Alternative 2A.

15 **Table 11-2A-64. Differences between Baseline and Alternative 2A Scenarios in the Number of**  
16 **Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern,**  
17 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
Red	11 (275%)	2 (13%)
Orange	1 (100%)	1 (50%)
Yellow	2 (100%)	-1 (-25%)
None	-14 (-19%)	-2 (-3%)

18  
19 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type  
20 during May through September (Table 11-2A-65). Total degree-days under Alternative 2A would be  
21 22% and 11% lower than under NAA during May and June, respectively, and 8% to 17% higher  
22 during July through September.

1 **Table 11-2A-65. Differences between Baseline and Alternative 2A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the**  
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
May	Wet	38 (292%)	-17 (-25%)
	Above Normal	0 (NA)	-5 (-100%)
	Below Normal	4 (NA)	2 (100%)
	Dry	0 (NA)	0 (NA)
	Critical	4 (NA)	3 (300%)
	All	46 (354%)	-17 (-22%)
June	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	6 (NA)	-12 (-67%)
	All	7 (NA)	-11 (-61%)
July	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	1 (NA)
	Dry	6 (NA)	6 (NA)
	Critical	734 (9,175%)	104 (16.3%)
	All	741 (9,263%)	111 (17%)
August	Wet	3 (NA)	0 (0%)
	Above Normal	1 (NA)	1 (NA)
	Below Normal	2 (NA)	2 (NA)
	Dry	125 (NA)	59 (89%)
	Critical	1,652 (822%)	91 (5%)
	All	1,783 (887%)	153 (8%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	16 (NA)	14 (700%)
	Below Normal	80 (NA)	67 (515%)
	Dry	556 (1,794%)	73 (14%)
	Critical	1,295 (485%)	33 (2%)
	All	1,947 (653%)	187 (9%)

NA = could not be calculated because the denominator was 0.

4

5 ***Feather River***

6 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
 7 during February through June, flows under A2A\_LLT would be similar to or greater than flows under  
 8 NAA during March through June except for March of below normal water years (8%) (Appendix 11C,  
 9 *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be very  
 10 few reductions in flows in the Feather River under Alternative 2A.

1 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
 2 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
 3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 5 NAA and Alternative 2A in any month or water year type throughout the period.

6 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
 7 was evaluated during May through September (Table 11-2A-66). For this impact, only the months of  
 8 May and June were examined because spawning and egg incubation does not generally extend  
 9 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In  
 10 both May and June, the percent of months exceeding the threshold under Alternative 2A would be  
 11 similar to or lower (up to 32% lower on an absolute scale) than the percent under NAA.

12 **Table 11-2A-66. Differences between Baseline and Alternative 2A Scenarios in Percent of Months**  
 13 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 14 **River at Gridley Exceed the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. A2A_LL1</b>					
May	27 (85%)	17 (93%)	12 (125%)	11 (300%)	7 (300%)
June	0 (0%)	-4 (-4%)	0 (0%)	0 (0%)	7 (15%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	26 (38%)
August	0 (0%)	0 (0%)	7 (8%)	17 (22%)	35 (56%)
September	10 (14%)	10 (18%)	23 (83%)	32 (433%)	25 (1,000%)
<b>NAA vs. A2A_LL1</b>					
May	-12 (-17%)	-21 (-37%)	-10 (-31%)	-4 (-20%)	-2 (-20%)
June	-6 (-6%)	-12 (-13%)	-16 (-17%)	-28 (-31%)	-32 (-37%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-2 (-3%)
August	0 (0%)	0 (0%)	-1 (-1%)	-2 (-2%)	0 (0%)
September	11 (16%)	5 (8%)	2 (5%)	-4 (-9%)	-1 (-4%)

15  
 16 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
 17 May through September (Table 11-2A-67). Only May and June were examined for spawning and egg  
 18 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-  
 19 months exceeding the threshold under Alternative 2A would be 11% to 23% lower than those under  
 20 NAA during May and June.

1 **Table 11-2A-67. Differences between Baseline and Alternative 2A Scenarios in Total Degree-**  
 2 **Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above**  
 3 **64°F in the Feather River at Gridley, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLТ	NAA vs. A2A_LLТ
May	Wet	18 (300%)	-6 (-20%)
	Above Normal	9 (82%)	-5 (-20%)
	Below Normal	17 (213%)	-7 (-22%)
	Dry	27 (193%)	-2 (-5%)
	Critical	20 (118%)	0 (0%)
	All	92 (164%)	-19 (-11%)
June	Wet	21 (28%)	-46 (-32%)
	Above Normal	-9 (-18%)	-38 (-48%)
	Below Normal	0 (0%)	-32 (-33%)
	Dry	42 (45%)	-11 (-7%)
	Critical	35 (63%)	-4 (-4%)
	All	89 (26%)	-131 (-23%)
July	Wet	46 (27%)	30 (16%)
	Above Normal	21 (40%)	4 (6%)
	Below Normal	44 (65%)	12 (12%)
	Dry	91 (106%)	47 (36%)
	Critical	75 (95%)	21 (16%)
	All	277 (61%)	114 (18%)
August	Wet	52 (29%)	35 (18%)
	Above Normal	39 (87%)	17 (25%)
	Below Normal	51 (73%)	19 (19%)
	Dry	100 (147%)	22 (15%)
	Critical	49 (58%)	-1 (-1%)
	All	291 (65%)	92 (14%)
September	Wet	-8 (-21%)	19 (158%)
	Above Normal	8 (50%)	17 (243%)
	Below Normal	36 (129%)	-4 (-6%)
	Dry	51 (182%)	-1 (-1%)
	Critical	53 (265%)	-1 (-1%)
	All	139 (106%)	29 (12%)

4

5 **San Joaquin River**

6 Flows in the San Joaquin River at Vernalis under Alternative 2A during March through June would  
 7 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
 8 *Analysis*).

9 No water temperatures modeling was conducted in the San Joaquin River.

10 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not  
 11 have the potential to substantially reduce the amount of suitable spawning and egg incubation

1 habitat or substantially reduce the number of individuals as a result of egg mortality. Flows in the  
2 Sacramento, Feather and San Joaquin River and water temperatures in the Sacramento and Feather  
3 Rivers under Alternative 2A would not be lower than those under NAA and therefore, would not to  
4 degrade spawning and egg incubation habitat conditions. Alternative 2A would reduce the  
5 frequency of exceedances above NMFS temperature thresholds in the Sacramento and Feather  
6 Rivers.

7 **CEQA Conclusion:** In general, Alternative 2A would not affect spawning and egg incubation habitat  
8 for green sturgeon relative to the Existing Conditions.

9 **Sacramento River**

10 In the Sacramento River between Keswick and upstream of Red Bluff during the March to July  
11 spawning and egg incubation period for green sturgeon, mean monthly flows under A2A\_LL2 would  
12 nearly always be similar to or greater than those under Existing Conditions, except in March during  
13 wet years (6% to 10% reduction depending on location), in May during wet years (14% to 15%  
14 reduction depending on location), and in July during critical years (12% reduction) (Appendix 11C,  
15 *CALSIM II Model Results utilized in the Fish Analysis*). Also flows can be lower or higher in individual  
16 months of individual years. These results indicate that there would be very few reductions in flows  
17 in the Sacramento River under Alternative 2A relative to the Existing Conditions.

18 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
19 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
20 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
21 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
22 Existing Conditions and Alternative 2A in any month or water year type throughout the period.

23 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was  
24 determined for each month (May through September) and year of the 82-year modeling period  
25 (Table 11-2A-64). The combination of number of days and degrees above the 63°F threshold were  
26 further assigned a “level of concern” as defined in Table 11-2A-11. Differences between baselines  
27 and Alternative 2A in the highest level of concern across all months and all 82 modeled years are  
28 presented in Table 11-2A-64. The number of “red” years would be 275% higher under Alternative  
29 2A relative to Existing Conditions.

30 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type  
31 during May through September (Table 11-2A-65). Water temperatures under Alternative 2A would  
32 exceed the threshold 46 degree-days (354%) and 7 degree-days (no relative change calculation  
33 possible due to division by 0) more than those under Existing Conditions during May and June,  
34 respectively.

35 **Feather River**

36 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
37 during February through June, flows under A2A\_LL2 would nearly always be similar to or greater  
38 than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
39 *Analysis*). The only exceptions would be in below normal, dry and critical years in February (8% to  
40 45% lower, in below normal and dry years during March (5% to 46% lower depending on location  
41 and water year type), in wet years during May (24% to 31% lower depending on location), and at  
42 the confluence during June of wet (8% reduction) and critical years (11% reduction). These results

1 indicate that there would be few reductions in flows in the Feather River under Alternative 2A  
2 relative to the Existing Conditions.

3 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
4 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would generally be no differences (<5%) in mean monthly water temperature  
7 between Existing Conditions and Alternative 2A in any month or water year type throughout the  
8 period, except during February and during below normal and critical years in March, in which mean  
9 monthly temperatures under Alternative 2A would be 6% higher than those under Existing  
10 Conditions.

11 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
12 was evaluated during May through September (Table 11-2A-66). For this impact, only the months of  
13 May and June were examined because spawning and egg incubation does not generally extend  
14 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131.  
15 During the period, the percent of months exceeding the threshold under Alternative 2A would be  
16 similar to or higher (up to 27% higher on an absolute scale) than the percent under Existing  
17 Conditions.

18 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
19 May through September (Table 11-2A-67). Only May and June were examined for spawning and egg  
20 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-  
21 months exceeding the threshold under Alternative 2A would be 164% to 26% higher than those  
22 under Existing Conditions during May and June.

### 23 ***San Joaquin River***

24 Flows in the San Joaquin River at Vernalis under Alternative 2A during March through June would  
25 not be different from flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results*  
26 *utilized in the Fish Analysis*).

### 27 **Summary of CEQA Conclusion**

28 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between  
29 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
30 alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the  
31 NEPA conclusion set forth above. Flows in the Sacramento, Feather, and San Joaquin River would  
32 generally be similar between Alternative 2A and the CEQA baseline, but the exceedance above NMFS  
33 temperature thresholds would be greater in the Sacramento and Feather Rivers under Alternative  
34 2A.

35 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
36 change, future water demands, and implementation of the alternative. The analysis described above  
37 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
38 the alternative from those of sea level rise, climate change and future water demands using the  
39 model simulation results presented in this chapter. However, the increment of change attributable  
40 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
41 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
42 implementation period, which does include future sea level rise, climate change, and water

1 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
2 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
3 effect of the alternative from those of sea level rise, climate change, and water demands.

4 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
5 term implementation period and Alternative 2A indicates that flows in the locations and during the  
6 months analyzed above would generally be similar between Existing Conditions during the LLT and  
7 Alternative 2A. This indicates that the differences between Existing Conditions and Alternative 2A  
8 found above would generally be due to climate change, sea level rise, and future demand, and not  
9 the alternative. As a result, the CEQA conclusion regarding Alternative 2A, if adjusted to exclude sea  
10 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
11 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is  
12 found to be less than significant and no mitigation is required.

### 13 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

14 In general, Alternative 2A would not affect the quantity and quality of green sturgeon larval and  
15 juvenile rearing habitat relative to NAA.

#### 16 ***Sacramento River***

17 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
18 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
19 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
20 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative  
21 2A in any month or water year type throughout the period.

#### 22 ***Feather River***

23 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
24 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
25 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
26 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in  
27 any month or water year type throughout the period.

28 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
29 was evaluated during May through September (Table 11-2A-66). The percent of months exceeding  
30 the threshold under Alternative 2A would be similar to or lower (up to 32% lower on an absolute  
31 scale) than the percent under NAA in all months except September, in which the percent of months  
32 under Alternative 2A would be 2% to 11% (absolute scale) higher than the percent under NAA.

33 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
34 May through September (Table 11-2A-67). Total degree-months exceeding the threshold under  
35 Alternative 2A would be 11% to 23% lower than those under NAA during May and June and 12% to  
36 18% greater than those under NAA during July through September.

#### 37 ***San Joaquin River***

38 Flows in the San Joaquin River at Vernalis under Alternative 2A during the March through June  
39 spawning and egg incubation periods would similar to those under NAA (Appendix 11C, *CALSIM II*  
40 *Model Results utilized in the Fish Analysis*).

1 Water temperature modeling was not conducted in the San Joaquin River.

2 **NEPA Effects:** Collectively, the results indicate that the effect would not be adverse because does not  
3 have the potential to substantially reduce suitable rearing habitat. Flows and water temperatures  
4 would not differ substantially between Existing Conditions and Alternative 2A in any river evaluated  
5 during the green sturgeon spawning and egg incubation period.

6 **CEQA Conclusion:** In general, Alternative 2A would not affect the quantity and quality of green  
7 sturgeon larval and juvenile rearing habitat relative to the Existing Conditions.

#### 8 **Sacramento River**

9 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
10 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
11 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
12 monthly water temperature under Alternative 2A would be similar to those under Existing  
13 Conditions during May and June, but 5% to 12% higher than those under Existing Conditions during  
14 July through October.

#### 15 **Feather River**

16 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
17 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
18 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
19 be no differences (<5%) in mean monthly water temperature between Existing Conditions and  
20 Alternative 2A in any month except August and in dry and critical years in July, in which  
21 temperatures under Alternative 2A would be 5% to 9% greater than those under Existing  
22 Conditions.

23 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley  
24 was evaluated during May through September (Table 11-2A-66). The percent of months exceeding  
25 the threshold under Alternative 2A would be similar to or greater (up to 32% higher on an absolute  
26 scale) than the percent under Existing Conditions in all months during the period.

27 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during  
28 May through September (Table 11-2A-67). Total degree-months exceeding the threshold under  
29 Alternative 2A would be 26% to 164% greater than those under Existing Conditions depending on  
30 month.

#### 31 **San Joaquin River**

32 Water temperature modeling was not conducted in the San Joaquin River.

33 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between  
34 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
35 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set  
36 forth above. Alternative 2A would cause higher temperatures for rearing larval and juvenile green  
37 sturgeon in the Sacramento and Feather River that could increase stress, mortality, and  
38 susceptibility to disease.

39 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
40 change, future water demands, and implementation of the alternative. The analysis described above

1 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
2 the alternative from those of sea level rise, climate change and future water demands using the  
3 model simulation results presented in this chapter. However, the increment of change attributable  
4 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
5 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
6 implementation period, which does include future sea level rise, climate change, and water  
7 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
8 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
9 effect of the alternative from those of sea level rise, climate change, and water demands.

10 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
11 term implementation period and Alternative 2A indicates that flows in the locations and during the  
12 months analyzed above would generally be similar between Existing Conditions during the LLT and  
13 Alternative 2A. This indicates that the differences between Existing Conditions and Alternative 2A  
14 found above would generally be due to climate change, sea level rise, and future demand, and not  
15 the alternative. As a result, the CEQA conclusion regarding Alternative 2A, if adjusted to exclude sea  
16 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
17 result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than  
18 significant and no mitigation is required.

#### 19 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

20 In general, Alternative 2A would reduce green sturgeon migration conditions relative to NAA.

21 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
22 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with  
23 the Sacramento River during the April through October larval migration period, the August through  
24 March juvenile migration period, and the November through June adult migration period (Appendix  
25 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the  
26 entire year, flows during all months were compared. Reduced flows could slow or inhibit  
27 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration  
28 cues and pass impediments by adults.

29 Sacramento River flows under A2A\_LLTT would generally be similar to or greater than flows under  
30 NAA in all months except July, August, and November, during which flows would be up to 28% lower  
31 depending on location, month, and water year type.

32 Larval transport flows were also examined by utilizing the positive correlation between white  
33 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the  
34 assumption that the mechanism responsible for the relationship is that Delta outflow provides  
35 improved green sturgeon larval transport that results in improved year class strength. Results for  
36 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation  
37 between Delta outflow and year class strength, green sturgeon year class strength would be lower  
38 under Alternative 2A.

39 Feather River flows under A2A\_LLTT would generally be lower by up to 52% than those under NAA  
40 during July through August. Flows during other months under A2A\_LLTT would generally be similar  
41 to or greater than flows under NAA with some exceptions.

1 **NEPA Effects:** Collectively, these results indicate that the effect is adverse because it has the  
2 potential to substantially interfere with the movement of green sturgeon. Reductions in flows in the  
3 Feather River during July through September would affect larval and juvenile migratory abilities by  
4 slowing or inhibiting downstream migration, but would not affect adult migration. Reductions in  
5 flows in the Sacramento River during July, August, and November would affect the migration of all  
6 three life stages.

7 This effect is a result of the specific reservoir operations and resulting flows associated with this  
8 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
9 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
10 the alternative, thereby making it a different alternative than that which has been modeled and  
11 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
12 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-132a through AQUA-  
13 132c) has the potential to reduce the severity of impact, although not necessarily to a not adverse  
14 level.

15 **CEQA Conclusion:** In general, Alternative 2A would reduce green sturgeon migration conditions  
16 relative to the Existing Conditions.

17 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
18 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with  
19 the Sacramento River during the April through October larval migration period, the August through  
20 March juvenile migration period, and the November through July adult migration period (Appendix  
21 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the  
22 entire year, flows during all months were compared. Reduced flows could slow or inhibit  
23 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration  
24 cues and pass impediments by adults.

25 Sacramento River flows under A2A\_LLT would generally be similar to or greater than flows under  
26 Existing Conditions in all months except August, September, and November. Flows during other  
27 months would generally be similar to or greater than flows under Existing Conditions.

28 Flows in the Feather River under A2A\_LLT would generally be up to 53% lower than flows under  
29 Existing Conditions in July, August, November, and December. Flows during other months under  
30 A2A\_LLT would generally be similar to or greater than flows under Existing Conditions.

31 For Delta outflow, the percent of months exceeding flow thresholds under A2A\_LLT would  
32 consistently be lower than those under Existing Conditions for each flow threshold, water year type,  
33 and month (8% to 75% lower on a relative scale) (Table 11-2A-73).

#### 34 **Summary of CEQA Conclusion**

35 Collectively, these results indicate that the impact would be significant because it has the potential  
36 to substantially interfere with the movement of fish. The reduction in flows in the Sacramento River  
37 during August, September, and December and in the Feather River during July, August, November,  
38 and December would affect larval, juvenile, and adult migration period, which could slow or inhibit  
39 their migration in both rivers. This impact is a result of the specific reservoir operations and  
40 resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
41 operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-  
42 significant level would fundamentally change the alternative, thereby making it a different  
43 alternative than that which has been modeled and analyzed. As a result, this impact is significant and

1 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation  
2 that has the potential to reduce the severity of impact though not necessarily to a less-than-  
3 significant level.

4 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**  
5 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**  
6 **Mitigation to Reduce Impacts to Migration Conditions**

7 Although analysis conducted as part of the EIR/EIS determined that Alternative 2A would have  
8 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
9 the best available scientific information at the time and may prove to have been overstated.  
10 Upon the commencement of operations of CM1 and continuing through the life of the permit, the  
11 BDCP proponents will monitor effects on migration habitat in order to determine whether such  
12 effects would be as extensive as concluded at the time of preparation of this document and to  
13 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
14 measure requires a series of actions to accomplish these purposes, consistent with the  
15 operational framework for Alternative 2A.

16 The development and implementation of any mitigation actions shall be focused on those  
17 incremental effects attributable to implementation of Alternative 2A operations only.  
18 Development of mitigation actions for the incremental impact on migration habitat attributable  
19 to climate change/sea level rise are not required because these changed conditions would occur  
20 with or without implementation of Alternative 2A.

21 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
22 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

23 Following commencement of initial operations of CM1 and continuing through the life of the  
24 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
25 modified operations could reduce impacts to migration habitat under Alternative 2A. The  
26 analysis required under this measure may be conducted as a part of the Adaptive Management  
27 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

28 **Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and**  
29 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
30 **Conditions Consistent with CM1**

31 In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon  
32 habitat, the BDCP proponents will consult with NMFS, USFWS and CDFW to identify and  
33 implement any feasible operational means to minimize effects on migration habitat. Any such  
34 action will be developed in conjunction with the ongoing monitoring and evaluation of habitat  
35 conditions required by Mitigation Measure AQUA-132a.

36 If feasible means are identified to reduce impacts on migration habitat consistent with the  
37 overall operational framework of Alternative 2A without causing new significant adverse  
38 impacts on other covered species, such means shall be implemented. If sufficient operational  
39 flexibility to reduce effects on green sturgeon habitat is not feasible under Alternative 2A  
40 operations, achieving further impact reduction pursuant to this mitigation measure would not  
41 be feasible under this Alternative, and the impact on green sturgeon would remain significant  
42 and unavoidable.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
3 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
4 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of  
5 restoration measures described for green sturgeon under Alternative 1A (Impact AQUA-133  
6 through AQUA-135) also appropriately characterize effects under Alternative 2A.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative  
8 2A.

9 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

10 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**  
11 **Sturgeon**

12 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

13 *NEPA Effects:* All three of these impact mechanisms have been determined to result in no adverse  
14 effects on green sturgeon for NEPA purposes. Specifically for AQUA-134, the effects of contaminants  
15 on green sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects  
16 of methylmercury and selenium on green sturgeon are uncertain.

17 *CEQA Conclusion:* All three of these impact mechanisms would be considered less than significant  
18 on green sturgeon, for the reasons identified for Alternative 1A, and no mitigation is required.

19 **Other Conservation Measures (CM12–CM19 and CM21)**

20 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
21 differences in other conservation-related fish effects are anticipated anywhere in the affected  
22 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish  
23 effects of other conservation measures described for green sturgeon under Alternative 1A (Impact  
24 AQUA-136 through AQUA-144) also appropriately characterize effects under Alternative 2A.

25 The following impacts are those presented under Alternative 1A that are identical for Alternative  
26 2A.

27 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

28 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
29 **(CM13)**

30 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

31 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
32 **(CM15)**

33 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

34 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

1 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

2 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

3 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
4 **Sturgeon (CM21)**

5 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
6 adverse effect, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified  
7 for Alternative 1A.

8 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
9 less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A,  
10 and no mitigation is required.

11 **White Sturgeon**

12 **Construction and Maintenance of CM1**

13 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

14 The potential effects of construction of the water conveyance facilities on white sturgeon would be  
15 similar to those described for Alternative 1A (Impact AQUA-145) except that Alternative 2A could  
16 potentially include two different intakes than under Alternative 1A. This would convert about  
17 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
18 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
19 feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
20 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
21 of contaminated sediments would be similar to Alternative 1A and the same environmental  
22 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
23 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
24 effects.

25 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and  
26 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
27 not be adverse for white sturgeon.

28 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-145, the impact of the construction  
29 of water conveyance facilities on white sturgeon would be less than significant except for  
30 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
31 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

32 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
33 **of Pile Driving and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

35 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
36 **and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

1 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

2 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
3 Alternative 2A would be the same as those described for Alternative 1A (see Impact AQUA-146). As  
4 concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse for white sturgeon.

5 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-146 for white sturgeon, the impact  
6 of the maintenance of water conveyance facilities on white sturgeon would be less than significant  
7 and no mitigation is required.

8 **Water Operations of CM1**

9 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

10 **Water Exports from SWP/CVP South Delta Facilities**

11 Alternative 2A is expected to substantially reduce overall entrainment of juvenile white sturgeon at  
12 the south Delta export facilities, estimated as salvage density, by about 66–69% across all years as  
13 compared to NAA (Table 11-2A-68). As discussed for Alternative 1A (Impact AQUA-3), entrainment  
14 is highest in wet and above normal water years. Under Alternative 2A, entrainment in wet and above  
15 normal water years would be reduced 68–71% for juveniles, compared to baseline conditions.  
16 Therefore, Alternative 2A would not have adverse effects on juvenile white sturgeon.

17 **Water Exports from SWP/CVP North Delta Intake Facilities**

18 The potential entrainment effects of operating the new north Delta intakes under Alternative 2A  
19 would be the same as described for Impact AQUA-129 under Alternative 1A. The intakes would have  
20 screens to avoid or reduce entrainment; there would be no adverse effect.

21 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

22 The potential entrainment effects of operating dual conveyance of the North Bay Aqueduct under  
23 Alternative 2A would be the same as described for Impact AQUA-129 under Alternative 1A. The  
24 intakes would have screens to avoid or reduce entrainment; there would be no adverse effect.

25 **Predation Associated with Entrainment**

26 Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to  
27 entrainment loss. Sturgeon develop bony scutes at a young age which reduces their predation  
28 vulnerability. The total reduction of juvenile white sturgeon entrainment, and hence predation loss,  
29 would change minimally between Alternative 2A and NAA (182 fish). Based on their early  
30 development of scutes and rapid growth rates, the number of juvenile white sturgeon lost to  
31 predation at the south Delta facilities would change negligibly between Alternative 2A and NAA. The  
32 impact and conclusion for predation risk associated with NPB structures and the north Delta intakes  
33 would be the same as described for Alternative 1A.

34 **NEPA Effects:** As concluded for Alternative 1A, the effect on entrainment and predation under  
35 Alternative 2A would not be adverse, because sturgeon grow rapidly and develop bony scutes early  
36 in their development which reduces their predation risk.

37 **CEQA Conclusion:** As described above, operational activities associated with water exports from  
38 SWP/CVP south Delta facilities would result in an overall decrease in entrainment of white sturgeon

1 under Alternative 2A compared to Existing Conditions (Table 11-2A-68; Existing Conditions vs.  
2 2A\_LLT). Impacts of Alternative 2A water operations on entrainment of white sturgeon would be  
3 beneficial due to an overall reduction in entrainment and no mitigation would be required.

4 **Table 11-2A-68. Juvenile White Sturgeon Entrainment Index<sup>a</sup> at the SWP and CVP Salvage Facilities**  
5 **for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between**  
6 **Model Scenarios**

Water Year <sup>b</sup>	Absolute Difference (Percent Difference)	
	NAA vs. A2A_LLT	EXISTING CONDITIONS vs. A2A_LLT
Wet and Above Normal	-164 (-68%)	-211 (-73%)
Below Normal, Dry, and Critical	-18 (-54%)	-25 (-61%)
All Years	-211 (-66%)	-182 (-72%)

<sup>a</sup> Estimated annual number of fish lost.  
<sup>b</sup> Sacramento Valley water year-types.

7

8 The impact of predation associated with entrainment would be the same as described immediately  
9 above because the rapid growth and development of bony scutes reduces the predation risk for  
10 juvenile white sturgeon. Since few juvenile white sturgeon are entrained at the south Delta,  
11 reductions in entrainment (69% reduction compared to Existing Conditions, representing 236 fish)  
12 under Alternative 2A would have little effect in affecting entrainment related predation loss. Overall,  
13 the impact would be less than significant, because there would be little change in predation loss  
14 under Alternative 2A.

15 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
16 **White Sturgeon**

17 In general, Alternative 2A would not affect spawning and egg incubation habitat for white sturgeon  
18 relative to NAA.

19 ***Sacramento River***

20 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
21 May spawning and egg incubation period for white sturgeon. Flows at Keswick under A2A\_LLT  
22 would always be similar to or greater than flows under NAA during February to May (Appendix 11C,  
23 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A2A\_LLT would be greater than  
24 those under NAA in 1 to 2 water years (up to 8% lower) during February through April, but would  
25 be similar to NAA during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
26 These results indicate that there would be reductions in flows in the Sacramento River during this  
27 period under Alternative 2A.

28 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
29 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
30 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
31 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in  
32 any month or water year type throughout the period.

1 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
 2 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
 3 of the 82-year modeling period (Table 11-2A-10). The combination of number of days and degrees  
 4 above each threshold were further assigned a “level of concern” as defined in Table 11-2A-11.  
 5 Differences between baselines and Alternative 2A in the highest level of concern across all months  
 6 and all 82 modeled years are presented in Table 11-2A-69. For the 61°F threshold, there would be  
 7 13 fewer (30% fewer) “red” years under Alternative 2A than under NAA. For the 68°F threshold,  
 8 there would be negligible differences in the number of years under each level of concern between  
 9 NAA and Alternative 2A.

10 **Table 11-2A-69. Differences between Baselines and Alternative 2A in the Number of Years in**  
 11 **Which Water Temperature Exceedances above the 61°F and 68°F Thresholds Are within Each Level**  
 12 **of Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
<b>61°F threshold</b>		
Red	36 (450%)	-13 (-30%)
Orange	-1 (-7%)	2 (14%)
Yellow	-15 (-48%)	6 (38%)
None	-20 (-71%)	5 (63%)
<b>68°F threshold</b>		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	1 (NA)	-2 (-200%)
None	-1 (-1%)	2 (2%)

NA = could not be calculated because the denominator was 0.

13  
 14 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
 15 Hamilton City during March through June (Table 11-2A-70, Table 11-2A-71). Total degree-days  
 16 exceeding the 61°F threshold under Alternative 2A would be 19% higher than those under NAA  
 17 during March, although this is an increase of only 3 degree-days, which would not cause biologically  
 18 meaningful effect to white sturgeon. During April through June, total degree days exceeding the  
 19 threshold would be 15% to 18% lower than those under NAA. Total degree-days exceeding the 68°F  
 20 threshold would not differ between NAA and Alternative 2A during March and April, but would be  
 21 45% to 55% lower under Alternative 2A than under NAA during May and June.

1 **Table 11-2A-70. Differences between Baseline and Alternative 2A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the**  
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	7 (NA)	3 (75%)
	Dry	11 (NA)	0 (0%)
	Critical	1 (NA)	0 (0%)
	All	19 (NA)	3 (19%)
April	Wet	65 (542%)	-1 (-1%)
	Above Normal	60 (600%)	-8 (-10%)
	Below Normal	62 (1,033%)	0 (0%)
	Dry	114 (224%)	-30 (-15%)
	Critical	15 (1,500%)	1 (7%)
	All	316 (395%)	-38 (-9%)
May	Wet	927 (278%)	-188 (-13%)
	Above Normal	207 (95%)	-144 (-25%)
	Below Normal	382 (208%)	-67 (-11%)
	Dry	237 (117%)	-196 (-31%)
	Critical	381 (189%)	31 (6%)
	All	2,134 (187%)	-564 (-15%)
June	Wet	514 (89%)	-444 (-29%)
	Above Normal	91 (30%)	-275 (-41%)
	Below Normal	387 (183%)	-115 (-16%)
	Dry	634 (189%)	-68 (-7%)
	Critical	589 (157%)	43 (5%)
	All	2,215 (123%)	-859 (-18%)

NA = could not be calculated because the denominator was 0.

4

1 **Table 11-2A-71. Differences between Baseline and Alternative 2A Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the**  
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
April	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
May	Wet	26 (371%)	-10 (-23%)
	Above Normal	0 (NA)	-20 (-100%)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	-2 (-100%)
	Critical	2 (NA)	1 (100%)
	All	29 (414%)	-30 (-45%)
June	Wet	4 (NA)	-4 (-50%)
	Above Normal	1 (100%)	-3 (-60%)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	11 (NA)	-16 (-59%)
	All	18 (1,800%)	-23 (-55%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
 7 during February to May, flows under A2A\_LLT would be similar to or greater than flows under NAA,  
 8 except for March of below normal water years (8%) (Appendix 11C, *CALSIM II Model Results utilized*  
 9 *in the Fish Analysis*). These results indicate that there would be very few reductions in flows in the  
 10 Feather River under Alternative 2A.

11 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
 12 confluence with the Sacramento River were examined during the February through May white  
 13 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ  
 14 between NAA and Alternative 2A at either location throughout the period.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis under Alternative 2A during February through May would  
3 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4 *Analysis*).

5 Water temperature modeling was not conducted for the San Joaquin River.

6 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not  
7 have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 2A  
8 are generally greater than or similar to flows under NAA. In addition, there would be no effect on  
9 water temperatures in the Sacramento and Feather Rivers or on exceedances above NMFS water  
10 temperature thresholds for spawning adults and egg incubation in the Sacramento River.

11 **CEQA Conclusion:** In general, under Alternative 2A water operations, the quantity and quality of  
12 spawning and egg incubation habitat for white sturgeon would not be affected relative to the CEQA  
13 baseline.

14 **Sacramento River**

15 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
16 May spawning and egg incubation period for white sturgeon. Flows at Keswick under A2A\_LLT  
17 would generally be similar to or greater than flows under Existing Conditions with few exceptions  
18 (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at  
19 Verona under A2A\_LLT would generally be similar to those under Existing Conditions except in  
20 February in which flows would be up to 8% lower. These results indicate that there would not be  
21 reductions in flows in the Sacramento River during this period under Alternative 2A.

22 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
23 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
24 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
25 be no differences (<5%) in mean monthly water temperature between Existing Conditions and  
26 Alternative 2A in any month or water year type throughout the period.

27 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
28 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
29 of the 82-year modeling period (Table 11-2A-10). The combination of number of days and degrees  
30 above each threshold were further assigned a “level of concern” as defined in Table 11-2A-11.  
31 Differences between baselines and Alternative 2A in the highest level of concern across all months  
32 and all 82 modeled years are presented in Table 11-2A-69. For the 61°F threshold, there would be  
33 36 more (450% increase) “red” years under Alternative 2A than under Existing Conditions. For the  
34 68°F threshold, there would be negligible differences in the number of years under each level of  
35 concern between Existing Conditions and Alternative 2A.

36 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
37 Hamilton City during March through June (Table 11-2A-70, Table 11-2A-71). Total degree-days  
38 exceeding the 61°F threshold under Alternative 2A would be 19 degree-days (percent change unable  
39 to be calculated due to division by 0) to 2215 degree-days (123%) higher depending on month.  
40 Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and  
41 Alternative 2A during March and April. During May and June, total degree-days would be 29 (414%)

1 and 18 (1800%) degree-days higher under Alternative 2A, although these small absolute differences  
2 would not cause a biologically meaningful effect on white sturgeon.

### 3 **Feather River**

4 In the Feather River between Thermalito Afterbay and the confluence with the Sacramento River  
5 during February to May, flows under A2A\_LLTT would generally be similar to or greater than those  
6 under Existing Conditions, except during February at Thermalito Afterbay, in which flows would be  
7 up to 45% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results  
8 indicate that there would be very few reductions in flows in the Feather River under Alternative 2A.

9 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
10 confluence with the Sacramento River were examined during the February through May white  
11 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality  
12 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
13 temperatures would not differ between Existing Conditions and Alternative 2A at either location  
14 throughout the period, except below Thermalito Afterbay during February, in which temperatures  
15 under Alternative 2A would be 6% higher than temperatures under Existing Conditions.

### 16 **San Joaquin River**

17 Flows in the San Joaquin River at Vernalis under Alternative 2A during the February through May  
18 period would be similar to or lower than flows under Existing Conditions in some water years  
19 during February and up to 16% lower during March through May.

20 Water temperature modeling was not conducted for the San Joaquin River.

### 21 **Summary of CEQA Conclusion**

22 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between  
23 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
24 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA  
25 conclusion set forth above. Flows in the San Joaquin River would be lower during a substantial  
26 portion of the spawning and egg incubation period. Lower flows could reduce white sturgeon  
27 spawning habitat availability or reduce water quality in spawning and egg incubation areas. Also,  
28 water temperatures under Alternative 2A in the Feather River would exceed NMFS thresholds at a  
29 substantially higher frequency than that under Existing Conditions. Elevated water temperatures  
30 can lead to reduced white sturgeon spawning success and higher egg mortality.

31 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
32 change, future water demands, and implementation of the alternative. The analysis described above  
33 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
34 the alternative from those of sea level rise, climate change and future water demands using the  
35 model simulation results presented in this chapter. However, the increment of change attributable  
36 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
37 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
38 implementation period, which does include future sea level rise, climate change, and water  
39 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
40 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
41 effect of the alternative from those of sea level rise, climate change, and water demands.

1 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
2 term implementation period and Alternative 2A indicates that flows in the locations and during the  
3 months analyzed above would generally be similar between Existing Conditions during the LLT and  
4 Alternative 2A. This indicates that the differences between Existing Conditions and Alternative 2A  
5 found above would generally be due to climate change, sea level rise, and future demand, and not  
6 the alternative. As a result, the CEQA conclusion regarding Alternative 2A, if adjusted to exclude sea  
7 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
8 result in a significant impact on spawning habitat for white sturgeon. This impact is found to be less  
9 than significant and no mitigation is required.

#### 10 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

11 In general, Alternative 2A would not affect the quantity and quality of white sturgeon larval and  
12 juvenile rearing habitat relative to NAA.

13 Water temperature was used to determine the potential effects of Alternative 2A on white sturgeon  
14 larval and juvenile rearing habitat because larvae and juveniles are benthic oriented and, therefore,  
15 their habitat is more likely to be limited by changes in water temperature than flow rates.

16 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
17 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water  
18 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
19 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in  
20 any month or water year type throughout the period.

21 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
22 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality  
23 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
24 differences (<5%) in mean monthly water temperature between NAA and Alternative 2A in any  
25 month or water year type throughout the period

26 Water temperatures were not modeled in the San Joaquin River.

27 **NEPA Effects:** These results indicate that the effect is not adverse because it does not have the  
28 potential to substantially reduce the amount of suitable rearing habitat. There would be no  
29 differences in water temperatures between the NEPA baseline and Alternative 2A in either the  
30 Sacramento or Feather Rivers throughout the white sturgeon rearing period.

31 **CEQA Conclusion:** In general, Alternative 2A would not affect the quantity and quality of white  
32 sturgeon larval and juvenile rearing habitat relative to the Existing Conditions.

33 Water temperature was used to determine the potential effects of Alternative 2A on white sturgeon  
34 larval and juvenile rearing habitat because larvae and juveniles are benthic oriented and, therefore,  
35 their habitat is more likely to be limited by changes in water temperature than flow rates.

36 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
37 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water  
38 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
39 monthly water temperatures would be similar between Existing Conditions and Alternative 2A  
40 during November through June, but up to 11% higher under Alternative 2A relative to Existing  
41 Conditions during August through October and in dry and critical years during July.

1 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
2 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality*  
3 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
4 temperatures would be similar between Existing Conditions during April through June and in most  
5 years during July and September, but 5% to 9% higher under Alternative 2A relative to Existing  
6 Conditions during August and October through February.

7 Water temperatures were not modeled in the San Joaquin River.

### 8 **Summary of CEQA Conclusion**

9 Collectively, the results of the Impact AQUA-149 CEQA analysis indicate that the difference between  
10 the CEQA baseline and Alternative 2A could be significant because, when compared to the CEQA  
11 baseline, the alternative could substantially reduce suitable rearing, contrary to the NEPA  
12 conclusion set forth above. There would be small, but persistent, increases in water temperatures  
13 during substantial portions of the larval and juvenile white sturgeon rearing period in both the  
14 Sacramento and Feather Rivers.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
16 change, future water demands, and implementation of the alternative. The analysis described above  
17 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
18 the alternative from those of sea level rise, climate change and future water demands using the  
19 model simulation results presented in this chapter. However, the increment of change attributable  
20 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
21 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
22 implementation period, which does include future sea level rise, climate change, and water  
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
27 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
28 locations and during the months analyzed above would generally be similar between Existing  
29 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
30 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
31 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
32 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
33 therefore would not in itself result in a significant impact on rearing habitat for white sturgeon. This  
34 impact is found to be less than significant and no mitigation is required.

### 35 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

36 In general, the effects of Alternative 2A on white sturgeon migration conditions relative to NAA are  
37 uncertain.

38 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins  
39 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number  
40 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)  
41 (Table 11-2A-72). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A2A\_LLТ were  
42 similar to those under NAA. The number of months per year above 31,000 cfs at Verona would range

1 from a reduction of 1.5 months (67% lower in wet years) to an increase of 0.8 months (350% higher  
2 in dry years) relative to NAA depending on water year type. Overall, there is no consistent difference  
3 between Alternative 2A and the baselines.

4 **Table 11-2A-72. Difference and Percent Difference in Number of Months between February and**  
5 **May in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough**  
6 **and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
<b>Wilkins Slough, 17,700 cfs<sup>a</sup></b>		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (5%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
<b>Wilkins Slough, 5,300 cfs<sup>b</sup></b>		
Wet	-0.2 (-2%)	0.04 (1%)
Above Normal	-0.3 (-4%)	0.1 (1%)
Below Normal	0.3 (5%)	0.6 (12%)
Dry	0.5 (10%)	0.2 (4%)
Critical	0.3 (10%)	0.3 (7%)
<b>Verona, 31,000 cfs<sup>a</sup></b>		
Wet	-1.8 (-72%)	-1.5 (-67%)
Above Normal	-0.5 (-30%)	-0.3 (-22%)
Below Normal	0.4 (71%)	0.4 (100%)
Dry	0.7 (260%)	0.8 (350%)
Critical	0 (0%)	0 (0%)

<sup>a</sup> Months analyzed: February through May.

<sup>b</sup> Months analyzed: November through May.

7

8 Larval transport flows were also examined by utilizing the positive correlation between year class  
9 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the  
10 mechanism responsible for the relationship is that Delta outflow provides improved larval transport  
11 that results in improved year class strength. The percent of months exceeding flow thresholds under  
12 A2A\_LLT generally be lower than those under NAA (up to 67%) with few exceptions (Table 11-2A-  
13 73). These results suggest that, using the positive correlation between Delta outflow and year class  
14 strength, year class strength would be lower under Alternative 2A.

1 **Table 11-2A-73. Difference and Percent Difference in Percentage of Months in Which Average**  
 2 **Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second in April**  
 3 **and May of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
<b>April</b>			
15,000 cfs	Wet	-8 (-8%)	-8 (-8%)
	Above Normal	-17 (-18%)	-17 (-18%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)
	Above Normal	-25 (-33%)	-17 (-25%)
25,000 cfs	Wet	-19 (-24%)	-15 (-20%)
	Above Normal	-25 (-43%)	-17 (-33%)
<b>May</b>			
15,000 cfs	Wet	-12 (-13%)	-4 (-5%)
	Above Normal	-25 (-30%)	0 (0%)
20,000 cfs	Wet	-38 (-45%)	-15 (-25%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-31 (-44%)	-19 (-33%)
	Above Normal	-25 (-75%)	-17 (-67%)
<b>April/May Average</b>			
15,000 cfs	Wet	-12 (-12%)	-4 (-4%)
	Above Normal	-25 (-25%)	-17 (-18%)
20,000 cfs	Wet	-23 (-26%)	-19 (-23%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-25 (-50%)	-25 (-50%)

4  
 5 For juveniles, year-round migration flows at Verona were more than 5% lower under A2A\_LLT  
 6 relative to NAA throughout much of the year under each water year type (Appendix 11C, *CALSIM II*  
 7 *Model Results utilized in the Fish Analysis*).

8 For adults, the average number of months per year during the November through May adult  
 9 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was  
 10 determined (Table 11-2A-72). The average number of months exceeding 5,300 cfs under A2A\_LLT  
 11 would generally be similar to the number of months under NAA, except in below normal (12%  
 12 higher), dry (9% higher), and critical (10% higher) water year types. These increase in exceedances  
 13 are considered small (<15%) and would not affect white sturgeon adult migration.

14 These results suggest that, using the positive correlation between Delta outflow and year class  
 15 strength, year class strength would be lower under Alternative 2A. However, there is high  
 16 uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta  
 17 outflows are caused by another unknown factor. There is no difference in the ability of Alternative  
 18 2A to meet flow targets in the Sacramento River relative to NAA (Table 11-2A-72).

19 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 2A and  
 20 NAA (Table 11-2A-72). However, due to the removal of water at the North Delta intakes, there are

1 substantial differences in through-Delta flows between Alternative 2A and NAA (Table 11-2A-73).  
2 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between  
3 year class strength and Delta outflow during April and May. However, this conclusion was reached in  
4 the absence of north Delta intakes and the exact mechanism that causes this correlation is not  
5 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper  
6 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another  
7 hypothesis suggests that the positive correlation is a result of higher flows through the Delta  
8 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some  
9 combination of these factors are working together to produce the positive correlation between high  
10 flows and sturgeon year-class strength.

11 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation  
12 between year class strength and river/Delta flow will be addressed through targeted research and  
13 monitoring to be conducted in the years leading up to the initiation of north Delta facilities  
14 operations. If these targeted investigations determine that the primary mechanisms behind the  
15 positive correlation between high flows and sturgeon year-class strength are related to upstream  
16 conditions, then Alternative 2A would be deemed Not Adverse due to the similarities in upstream  
17 flow conditions between Alternative 2A and NAA. However, if the targeted investigations lead to a  
18 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and  
19 through-Delta flow conditions, then Alternative 2A would be deemed Adverse due to the magnitude  
20 of reductions in through-Delta flow conditions in Alternative 2A as compared to NAA.

21 **CEQA Conclusion:** In general, under Alternative 2A water operation, migration conditions for white  
22 sturgeon would not change relative to the CEQA baseline.

23 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough  
24 under A2A\_LLT would be similar to those under Existing Conditions in wet, dry, and critical years  
25 (Table 11-2A-72). The number of months per year above 17,000 cfs at Wilkins Slough under  
26 A2A\_LLT would be 18% greater than under Existing Conditions in above normal years and 25%  
27 lower than under Existing Conditions in below normal water years. The number of months per year  
28 above 31,000 cfs at Verona would range from a reduction of 1.8 months (72% reduction in wet  
29 years) to an increase of 0.7 months (260% higher in dry years) relative to Existing Conditions  
30 depending on water year type.

31 For Delta outflow, the percent of months exceeding flow thresholds under A2A\_LLT would  
32 consistently be lower than those under Existing Conditions for each flow threshold, water year type,  
33 and month (8% to 75% lower on a relative scale) (Table 11-2A-73).

34 For juveniles, year-round migration flows would be more than 5% lower under A2A\_LLT relative to  
35 Existing Conditions throughout much of the year under each water year type (Appendix 11C,  
36 *CALSIM II Model Results utilized in the Fish Analysis*).

37 For adult migration, the average number of months exceeding 5,300 cfs under A2\_LLT would  
38 generally be similar to the number of months under Existing Conditions, except in below normal  
39 (5% higher) and in dry and critical water years (10% higher in both) (Table 11-2A-72).

#### 40 **Summary of CEQA Conclusion**

41 The results of the AQUA-150 CEQA analysis indicate that the difference between the CEQA baseline  
42 and Alternative 2A could be significant because, under the CEQA baseline, the alternative could  
43 substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above.

1 As discussed above, the Delta outflow-white sturgeon year class strength correlation has high  
2 uncertainty such that it is not possible to determine whether reduced outflow would result in a  
3 significant impact. However, the inability of Alternative 2A to meet flow targets in the Sacramento  
4 River relative to the Existing Conditions would have biologically meaningful effects on white  
5 sturgeon (Table 11-2A-72).

6 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
7 change, future water demands, and implementation of the alternative. The analysis described above  
8 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
9 the alternative from those of sea level rise, climate change and future water demands using the  
10 model simulation results presented in this chapter. However, the increment of change attributable  
11 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
12 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
13 implementation period, which does include future sea level rise, climate change, and water  
14 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
15 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
16 effect of the alternative from those of sea level rise, climate change, and water demands.

17 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
18 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
19 locations and during the months analyzed above would generally be similar between Existing  
20 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
21 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
22 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
23 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion of not  
24 adverse, and therefore would not in itself result in a significant impact on migration conditions for  
25 white sturgeon. Additionally, as described above in the NEPA Effects statement, further  
26 investigation is needed to better understand the association of Delta outflow to sturgeon  
27 recruitment, and if needed, adaptive management would be used to make adjustments to meet the  
28 biological goals and objectives. This impact is found to be less than significant and no mitigation is  
29 required.

### 30 **Restoration Measures (CM2, CM4–CM7, and CM10)**

31 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
32 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
33 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of  
34 restoration measures described for white sturgeon under Alternative 1A (Impact AQUA-151  
35 through AQUA-153) also appropriately characterize effects under Alternative 2A.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative  
37 2A.

### 38 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

### 39 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 40 **Sturgeon**

### 41 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

1 **NEPA Effects:** All three of these impact mechanisms have been determined to result in no adverse  
2 effects on white sturgeon for NEPA purposes. Specifically for AQUA-152, the effects of contaminants  
3 on white sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects  
4 of methylmercury and selenium on white sturgeon are uncertain.

5 **CEQA Conclusion:** All three of these impact mechanisms would be considered less than significant  
6 on white sturgeon, for the reasons identified for Alternative 1A, and no mitigation is required.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
9 differences in other conservation-related fish effects are anticipated anywhere in the affected  
10 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish  
11 effects of other conservation measures described for white sturgeon under Alternative 1A (Impact  
12 AQUA-154 through AQUA-162) also appropriately characterize effects under Alternative 2A.

13 The following impacts are those presented under Alternative 1A that are identical for Alternative  
14 2A.

15 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

16 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**  
17 **(CM13)**

18 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

19 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**  
20 **(CM15)**

21 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

22 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

23 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

24 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

25 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**  
26 **Sturgeon (CM21)**

27 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
28 adverse effect, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified  
29 for Alternative 1A.

30 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
31 less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A,  
32 and no mitigation is required.

1 **Pacific Lamprey**

2 **Construction and Maintenance of CM1**

3 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

4 The potential effects of construction of the water conveyance facilities on Pacific lamprey would be  
5 similar to those described for Alternative 1A (Impact AQUA-163) except that Alternative 2A could  
6 potentially include two different intakes than under Alternative 1A. This would convert about  
7 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
8 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
9 feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
10 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
11 of contaminated sediments would be similar to Alternative 1A and the same environmental  
12 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
13 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
14 effects.

15 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and  
16 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
17 not be adverse for Pacific lamprey.

18 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-163, the impact of the construction  
19 of water conveyance facilities on Pacific lamprey would be less than significant except for  
20 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
21 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

22 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
23 **of Pile Driving and Other Construction-Related Underwater Noise**

24 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

25 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
26 **and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

28 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

29 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
30 Alternative 2A would be the same as those described for Alternative 1A (see Impact AQUA-164). As  
31 concluded in Alternative 1A, Impact AQUA-164, the effect would not be adverse for Pacific lamprey.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance  
33 of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation is  
34 required.

1 **Water Operations of CM1**

2 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

3 **Water Exports**

4 Alternative 2A is expected to substantially reduce average annual entrainment of Pacific lamprey,  
5 estimated by salvage density, by about 59–60% (Table 11-2A-74) averaged across all years  
6 compared to NAA.

7 The potential entrainment impacts of Alternative 2A on Pacific lamprey would be the same as  
8 described above for Alternative 1A (Impact AQUA-165). These actions would avoid or reduce  
9 potential entrainment and the effect is not adverse.

10 The analysis of Pacific lamprey and river lamprey entrainment at the SWP/CVP south Delta facilities  
11 is combined because the salvage facilities do not distinguish between the two lamprey species.  
12 Similar to Alternative 1A (Impact AQUA-165), Alternative 2A is not expected to have an adverse  
13 effect on lamprey.

14 **Predation Associated with Entrainment**

15 Lamprey predation loss at the south Delta facilities is assumed to be proportional to entrainment  
16 loss. Average pre-screen predation loss for fish entrained at the south Delta is 75% at Clifton Court  
17 Forebay and 15% at the CVP. Lamprey entrainment to the south Delta would be reduced by 59–60%  
18 compared to NAA and predation losses would be expected to be reduced at a similar proportion. The  
19 impact and conclusion for predation risk associated with NPB structures would be the same as  
20 described for Alternative 1A.

21 **NEPA Effects:** Predation at the north Delta would be increased due to the construction of the  
22 proposed water export facilities on the Sacramento River. The effect on lamprey from predation loss  
23 at the north Delta is unknown because of the lack of knowledge about their distribution and  
24 population abundances in the Delta. As described for Alternative 1A, the overall effect on  
25 entrainment and predation of lamprey is considered not adverse.

26 **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be decreased  
27 under Alternative 2A by approximately 60% compared to Existing Conditions (Table 11-2A-74). At  
28 the north Delta facilities and the alternate NBA intake, the screened intakes as designed would  
29 exclude this species. Decommissioning agricultural diversions would slightly reduce potential  
30 entrainment. Impacts of Alternative 2A water operations on entrainment on Pacific lamprey are  
31 anticipated to be less than significant and may be beneficial, due to reductions in entrainment at the  
32 Delta export facilities. No mitigation would be required.

33 **Table 11-2A-74. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for**  
34 **Alternative 2A<sup>a</sup>**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
All Years	-2,044 (-60%)	-1,939 (-59%)

<sup>a</sup> Number of fish lost, based on non-normalized data, for all months.

35

1 The impact of predation associated with entrainment would be the same as described immediately  
2 above because the additional predation losses associated with the proposed north Delta intakes  
3 would be offset by the reduction in predation loss at the south Delta. The relative impact of  
4 predation loss on the lamprey population is unknown since there is little available knowledge on  
5 their distribution and abundance in the Delta. The impact is considered to be less than significant.  
6 No mitigation is required.

### 7 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 8 **Pacific Lamprey**

9 In general, effects of Alternative 2A would not affect the quantity and quality of Pacific lamprey  
10 spawning habitat relative to NAA.

11 Flow-related impacts on Pacific lamprey spawning habitat were evaluated by estimating effects of  
12 flow alterations on egg exposure, called redd dewatering risk, and effects on water temperature. A  
13 redd is a gravel-covered nest of eggs; Pacific lamprey eggs take between 18 and 49 days to incubate  
14 and must remain covered by sufficient water for that time. Rapid reductions in flow can dewater  
15 redds leading to mortality. Locations for each river used in the dewatering risk analysis were based  
16 on available literature, personal conversations with agency experts, and spatial limitations of the  
17 CALSIM II model, and include the Sacramento River at Keswick, Sacramento River at Red Bluff,  
18 Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, and American River at  
19 Nimbus Dam and at the confluence with the Sacramento River. Pacific lamprey spawn in these rivers  
20 between January and August so flow reductions during those months have the potential to dewater  
21 redds, which could result in incomplete development of the eggs to ammocoetes (the larval stage).  
22 Water temperature results from the SRWQM and the Reclamation Temperature Model were used to  
23 assess the exceedances of water temperatures under all model scenarios in the upper Sacramento,  
24 Trinity, Feather, American, and Stanislaus rivers.

25 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-  
26 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning  
27 location suitability characteristics (e.g., depth, velocity, substrate) of Pacific lamprey are not  
28 adequately described to employ a more formal analysis such as a weighted usable area analysis.  
29 Therefore, the change in month-over-month flows is used as a surrogate for a more formal analysis,  
30 and a month-over-month flow reduction of 50% was chosen as a best professional estimate of flow  
31 conditions in which redd dewatering is expected to occur, but does not estimate empirically derived  
32 redd dewatering events. As such, there is uncertainty that these values represent actual redd  
33 dewatering events, and results should be treated as rough estimates of flow fluctuations under each  
34 model scenario. Results were expressed as the number of cohorts exposed to dewatering risk and as  
35 a percentage of the total number of cohorts anticipated in the river based on the applicable time-  
36 frame, January to August.

37 Flows in all rivers evaluated indicate an increase in redd cohorts exposed to month-over-month flow  
38 reductions between January and August for Alternative 2A compared to NAA would only occur in  
39 the Feather River, which would consist of a small increase in dewatering risk (9 cohorts or 8%)  
40 (Table 11-2A-75). These results indicate no effect of Alternative 2A on the number of Pacific  
41 lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than  
42 50% in the Sacramento, Trinity, and American Rivers. Alternative 2A would result in a small  
43 increase (8%) in the number of cohorts predicted to experience a month-over-month change of flow

1 greater than 50% in the Feather River which would not constitute have biologically meaningful  
2 effects.

3 **Table 11-2A-75. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**  
4 **Cohorts<sup>a</sup>**

Location	Comparison <sup>b</sup>	EXISTING CONDITIONS	
		vs. A2A_LLТ	NAA vs. A2A_LLТ
Sacramento River at Keswick	Difference	9	-13
	Percent Difference	16%	-17%
Sacramento River at Red Bluff	Difference	8	-10
	Percent Difference	15%	-14%
Trinity River down-stream of Lewiston	Difference	0	0
	Percent Difference	0%	0%
Feather River at Thermalito Afterbay	Difference	-33	9
	Percent Difference	-22%	8%
American River at Nimbus Dam	Difference	36	-1
	Percent Difference	42%	-1%
American River at Sacramento River confluence	Difference	40	0
	Percent Difference	42%	0%

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

<sup>b</sup> Positive values indicate a higher value in Alternative 2A than in the baseline.

5  
6 Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C  
7 (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the  
8 number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least  
9 one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis  
10 predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C  
11 (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual  
12 day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River,  
13 corresponding to 82 years of eggs being laid every day each year from January 1 through August 31,  
14 and 648 cohorts for the other rivers using monthly data over the same period. The incubation  
15 periods used in this analysis are conservative and represent the extreme long end of the egg  
16 incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited  
17 because the extreme temperatures are masked; however, no better analytical tools are currently  
18 available for this analysis. Exact spawning locations of Pacific lamprey are not well defined.  
19 Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

20 In most locations, egg cohort exposure would not differ between NAA and Alternative 2A (Table 11-  
21 2A-76). However, the number of cohorts exposed to 22°C (71.6°F) under Alternative 2A would be  
22 11% higher in the Sacramento River at Hamilton City and 61% higher in the Feather River at  
23 Thermalito Afterbay. The increase in the Sacramento River is negligible considering that it  
24 represents a difference of <0.1% of the total number of egg cohorts evaluated (19,928 cohorts).

1 **Table 11-2A-76. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg**  
2 **Cohort Temperature Exposure<sup>a</sup>**

Location	EXISTING CONDITIONS vs.	
	A2A_LLТ	NAA vs. A2A_LLТ
Sacramento River at Keswick	51 (NA)	0 (0%)
Sacramento River at Hamilton City	1,188 (NA)	120 (11%)
Trinity River at Lewiston	6 (NA)	1 (20%)
Trinity River at North Fork	15 (NA)	-3 (-17%)
Feather River at Fish Barrier Dam	0 (NA)	-1 (-100%)
Feather River below Thermalito Afterbay	124 (517%)	56 (61%)
American River at Nimbus	71 (645%)	-3 (-4%)
American River at Sacramento River Confluence	161 (288%)	1 (0%)
Stanislaus River at Knights Ferry	2 (NA)	0 (0%)
Stanislaus River at Riverbank	87 (4,350%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F during January to August on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

3

4 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because Alternative  
5 2A does not have the potential to substantially reduce suitable spawning habitat and substantially  
6 reduce the number of fish as a result of egg mortality. Flows reductions that increase redd  
7 dewatering risk would be of similar or lower frequency under Alternative 2A relative to the NEPA  
8 baseline in all locations except the in Feather River at Thermalito Afterbay, in which there is a small  
9 (9%) increase. There would be increased exposure risk of eggs to elevated temperatures in the  
10 Feather River, but this isolated result is not expected to cause a biologically meaningful effect to the  
11 Pacific lamprey population.

12 **CEQA Conclusion:** In general, Alternative 2A would not affect the quantity and quality of Pacific  
13 lamprey spawning habitat relative to the Existing Conditions.

14 Rapid reductions in flow can dewater redds leading to mortality. In the Sacramento American  
15 Rivers, Alternative 2A would increase in the number of redd cohorts predicted to experience a  
16 month-over-month change in flow of greater than 50% relative to Existing Conditions (Table 11-2A-  
17 75). The small values (9 and 8 cohorts) in the Sacramento River would not translate into biologically  
18 meaningful effects considering the total number of redd cohorts evaluated (656 cohorts). Changes  
19 would be most substantial for the American River (increased risk of dewatering exposure to 36  
20 cohorts or 43% at Nimbus Dam, and 40 cohorts or 42% at the confluence). For the Feather River,  
21 there are 25 fewer redd cohorts (-33 cohorts or -17%) predicted to experience a month-over-month  
22 change in flow of greater than 50% for Alternative 2A relative to Existing Conditions. No effects are  
23 predicted for the Trinity River (0%). These results indicate that Alternative 2A would not have  
24 biologically meaningful effects on Pacific lamprey redd dewatering risk in the Sacramento, Feather,  
25 and Trinity Rivers; but would affect dewatering risk in the Sacramento River and the American  
26 River (maximum increases of 36 cohorts or 43% at Nimbus Dam and 40 cohorts or 42% at the  
27 confluence).

1 The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 2A would be greater than  
2 that under Existing Conditions in all rivers (Table 11-1A-76).

### 3 **Summary of CEQA Conclusion**

4 Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between  
5 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
6 alternative could substantially reduce suitable spawning habitat and substantially reduce the  
7 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Redd  
8 dewatering risk under Alternative 2A would be higher relative to Existing Conditions in the  
9 American River, which would increase the risk of desiccation of eggs in this river. There would be  
10 increases in egg cohorts exposed to water temperatures above 71.6°F under Alternative 2A relative  
11 to Existing Conditions in at least one location in all rivers evaluated. Increased exposure to elevated  
12 temperatures would reduce egg survival in these rivers.

13 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
14 change, future water demands, and implementation of the alternative. The analysis described above  
15 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
16 the alternative from those of sea level rise, climate change and future water demands using the  
17 model simulation results presented in this chapter. However, the increment of change attributable  
18 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
19 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
20 implementation period, which does include future sea level rise, climate change, and water  
21 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
22 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
23 effect of the alternative from those of sea level rise, climate change, and water demands.

24 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
25 term implementation period and Alternative 2A indicates that flows in the locations and during the  
26 months analyzed above would generally be similar between Existing Conditions during the LLT and  
27 Alternative 2A. This indicates that the differences between Existing Conditions and Alternative 2A  
28 found above would generally be due to climate change, sea level rise, and future demand, and not  
29 the alternative. As a result, the CEQA conclusion regarding Alternative 2A, if adjusted to exclude sea  
30 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
31 result in a significant impact on spawning habitat for Pacific lamprey. This impact is found to be less  
32 than significant and no mitigation is required.

### 33 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

34 In general, Alternative 2A would have negligible effects on Pacific lamprey rearing habitat  
35 conditions relative to NAA.

36 Flow-related impacts to Pacific lamprey rearing habitat were evaluated by estimating effects of flow  
37 alterations on ammocoete exposure, called ammocoete stranding risk. Lower flows can reduce the  
38 instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to  
39 mortality. Comparisons of effects were made for ammocoete cohorts in the Sacramento River at  
40 Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus Dam and  
41 at the confluence with the Sacramento River. An ammocoete is the filter-feeding larval stage of the  
42 lamprey that remains relatively immobile in the sediment in the same location for 5 to 7 years, after

1 which it migrates downstream. During the upstream rearing period there is potential for  
2 ammocoete stranding from rapid reductions in flow.

3 The analysis of ammocoete stranding was conducted by analyzing a range of month-over-month  
4 flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of  
5 ammocoetes was assumed to be born every month during their spawning period (January through  
6 August) and spend 7 years rearing upstream. Therefore, a cohort was considered stranded if at least  
7 one month-over-month flow reduction was greater than the flow reduction at any time during the  
8 period.

9 Effects of Alternative 2A on Pacific lamprey ammocoete stranding were analyzed by calculating  
10 month-over-month flow reductions for the Sacramento River at Keswick for January through August  
11 (Table 11-2A-77). Results indicate either no effect (0%), negligible effects (<5%), or decreases (-  
12 12%) in the occurrence of flow reductions attributable solely to the project.

13 **Table 11-2A-77. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
14 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**  
15 **Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	0	
-65%	0	3
-70%	4	-2
-75%	1	-3
-80%	4	-12
-85%	2	0
-90%	NA	NA

NA = all values were 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

16  
17 Results of comparisons for the Sacramento River at Red Bluff provide similar conclusions, with  
18 slightly more variability in results (Table 11-2A-78). Results for Alternative 2A compared to NAA  
19 indicate no change (0%), negligible increases (<5%), and small to moderate decreases (-7 to -12%)  
20 attributable to the project that would not have biologically meaningful effects on stranding risk.

1 **Table 11-2A-78. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 3 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	4	0
-60%	7	5
-65%	-2	-3
-70%	9	-2
-75%	-3	-12
-80%	5	-7
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

4  
 5 Comparisons for the Trinity River indicate no effect (0%) or (negligible changes ±3%) attributable  
 6 to the project (Table 11-2A-79).

7 **Table 11-2A-79. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 8 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	21	-3
-80%	27	0
-85%	18	0
-90%	41	3

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

9  
 10 In the Feather River, all comparisons resulted in no difference (0%) or reductions in the occurrence  
 11 of flow reductions between 50-90% (Table 11-2A-80).

1 **Table 11-2A-80. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
 3 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-1	1
-85%	-24	-42
-90%	-64	-28

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

4  
 5 Comparisons for the American River at Nimbus Dam (Table 11-2A-81) and at the confluence with  
 6 the Sacramento River (Table 11-2A-82) indicate negligible increases (2%) or substantial decreases  
 7 (-1 to -60%) attributable to the project (Table 11-2A-81), with an increase of 14% for only one flow  
 8 reduction category, 80% flow reduction, for the confluence.

9 **Table 11-2A-81. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
 11 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	34	-4
-75%	96	2
-80%	236	-11
-85%	336	-14
-90%	25	-58

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

12

1 **Table 11-2A-82. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	7	-1
-75%	35	-1
-80%	236	14
-85%	221	-8
-90%	168	-36

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

4  
 5 These results indicate that Alternative 2A would primarily have no effect (0%), negligible effects  
 6 (<5%), or decreases in stranding risk that would be beneficial to on rearing success. Isolated  
 7 occurrences of small increases in dewatering for some flow reduction categories would not have  
 8 biologically meaningful effects. There would also be small, beneficial effects in the Sacramento River  
 9 (decreased occurrence of month-over-month flow reductions to -12%) and more substantial  
 10 beneficial effects in the American River (decreased occurrence of flow reductions to -60%) due to  
 11 project-related effects of Alternative 2A.

12 To evaluate water temperature-related effects of Alternative 2A on Pacific lamprey ammocoetes, we  
 13 examined the predicted number of ammocoete “cohorts” that experience water temperatures  
 14 greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature  
 15 data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers  
 16 over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each  
 17 individual day or month starts a new “cohort” such that there are 18,244 cohorts for the Sacramento  
 18 River, corresponding to 82 years of ammocoetes being “born” every day each year from January 1  
 19 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

20 In general, there would be no differences in the number of ammocoete cohorts exposed to  
 21 temperatures greater than 71.6°F in each river (Table 11-2A-83). There would be 23 more cohorts  
 22 (20% increase) exposed under Alternative 2A in the Trinity River at Lewiston, but there would be  
 23 22 fewer cohorts (7% decrease) exposed at North Fork. In addition, there would be 72 more cohorts  
 24 (14% increase) exposed under Alternative 2A in the Feather River below Thermalito Afterbay, but  
 25 there would be 56 fewer cohorts (100% decrease) fewer exposed at Fish Barrier Dam. Overall, the  
 26 small to moderate increases and decreases will balance out within rivers such that there would be  
 27 no overall effect on Pacific lamprey ammocoetes.

1 **Table 11-2A-83. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F in at Least**  
 3 **One Day or Month**

Location	EXISTING CONDITIONS	
	vs. A2A_LL1	NAA vs. A2A_LL1
Sacramento River at Keswick <sup>b</sup>	1,705 (NA)	0 (0%)
Sacramento River at Hamilton City <sup>b</sup>	12,464 (NA)	1,209 (11%)
Trinity River at Lewiston	136 (NA)	23 (20%)
Trinity River at North Fork	283 (NA)	-22 (-7%)
Feather River at Fish Barrier Dam	0 (NA)	-56 (-100%)
Feather River below Thermalito Afterbay	211 (55%)	72 (14%)
American River at Nimbus	359 (185%)	-8 (-1%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	56 (NA)	0 (0%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Positive values indicate a higher value in Alternative 2A than in EXISTING CONDITIONS or NAA.

<sup>b</sup> Based on daily data; all other locations use monthly data; 1922–2003.

4

5 **NEPA Effects:** These results indicate that the effect would not be adverse because it would not  
 6 substantially reduce rearing habitat or substantially reduce the number of fish as a result of  
 7 ammocoete mortality. There would be negligible effects on ammocoete cohort survival under  
 8 Alternative 2A relative to the NEPA baseline for all locations. There would be increase and decreases  
 9 in exposure risk of ammocoetes to elevated temperatures within each river evaluated that would  
 10 balance out such that there would be no net effect on Pacific lamprey ammocoetes.

11 **CEQA Conclusion:** In general, under Alternative 2A water operations, the quantity and quality of  
 12 Pacific lamprey rearing habitat would not be affected relative to the CEQA baseline

13 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can  
 14 strand ammocoetes leading to mortality. Comparisons of Alternative 2A to Existing Conditions for  
 15 the Sacramento River at Keswick indicate negligible changes (<5%) in occurrence of flow reductions  
 16 for all flow reduction categories (Table 11-2A-77). Comparisons for the Sacramento River at Red  
 17 Bluff indicate no effect (0%) or negligible effects (±5%) for all flow reduction categories except for  
 18 60%, 70% and 85% flow reductions (increases of 7%, 9% and 100% [from 56 to 112], respectively)  
 19 (Table 11-2A-78). Increases of 18-41% are predicted for flow reduction categories from 75% to  
 20 90% for the Trinity River (Table 11-2A-79) based on increases from approximately 400 to 500  
 21 ammocoete cohorts exposed to stranding risk.

22 The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under  
 23 Alternative 2A would be substantially higher than those under Existing Conditions in at least one  
 24 location in all rivers evaluated (Table 11-1A-83).

25 **Summary of CEQA Conclusion**

26 The results of the Impact AQUA-167 CEQA analysis indicate that that the difference between the  
 27 CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the

1 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
2 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Increased water  
3 temperatures would increase stress and reduce survival of lamprey ammocoetes. In the Sacramento  
4 River, Trinity River, and the American River at Nimbus Dam and at the confluence with the  
5 Sacramento River, there would be substantial increases in the number of cohorts exposed to  
6 stranding risk due to flow reductions in each of the higher flow reduction categories. Increased  
7 stranding risk in these rivers would increase the risk of desiccation and reduce survival of  
8 ammocoete cohorts. There would be no effect on ammocoete stranding risk under Alternative 2A  
9 relative to Existing Conditions in the Feather River, and small increases in stranding risk for the  
10 Sacramento River at Red Bluff that would not have biologically meaningful effects. Exposure of  
11 ammocoetes to elevated temperatures under Alternative 2A would be substantially higher than  
12 those under Existing Conditions in at least one location in all rivers evaluated.

13 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
14 change, future water demands, and implementation of the alternative. The analysis described above  
15 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
16 the alternative from those of sea level rise, climate change and future water demands using the  
17 model simulation results presented in this chapter. However, the increment of change attributable  
18 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
19 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
20 implementation period, which does include future sea level rise, climate change, and water  
21 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
22 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
23 effect of the alternative from those of sea level rise, climate change, and water demands.

24 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
25 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
26 locations and during the months analyzed above would generally be similar between Existing  
27 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
28 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
29 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
30 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
31 therefore would not in itself result in a significant impact on rearing habitat for Pacific lamprey. This  
32 impact is found to be less than significant and no mitigation is required.

### 33 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

34 In general, effects of Alternative 2A would be negligible relative to NAA based on a prevalence of  
35 negligible effects or beneficial increases in mean monthly flow for most of the locations analyzed,  
36 which would have a beneficial effect on migration conditions.

37 After 5–7 years, Pacific lamprey ammocoetes migrate downstream and become macrophthalmia  
38 (juveniles) once they reach the Delta. Migration generally is associated with large flow pulses in  
39 winter months (December through March) (USFWS unpubl. data) meaning alterations in flow have  
40 the potential to affect downstream migration conditions. The effects of Alternative 2A on seasonal  
41 migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow output. Flow  
42 rates along the migration pathways of Pacific lamprey during the likely migration period (December  
43 through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River

1 at the confluence with the Sacramento River, and the American River at the confluence with the  
2 Sacramento River.

3 CALSIM flow data form the basis for the summary of changes in adult lamprey migration flows.

#### 4 ***Sacramento River***

5 Macrophthalmia The difference in mean monthly flow rate for the Sacramento River at Rio Vista for  
6 December to May for Alternative 2A compared to NAA indicates reductions in flow for most  
7 months/water year types in the migration period with persistent flow reductions ranging from -5%  
8 to -31% depending on the specific month and water year (*Appendix 11C, CALSIM II Model Results*  
9 *utilized in the Fish Analysis*). There would be project-related decreases in flow during January to  
10 April in dry and critical years (to -18%) when reductions in flow would have the greatest effect on  
11 migration conditions. The project-related decreases in flow in the Sacramento River at Rio Vista  
12 could adversely affect outmigrating macrophthalmia during these months.

13 For the Sacramento River at Red Bluff, the difference in mean monthly flow rate for Alternative 2A  
14 compared to NAA indicate negligible effects (<5%) on flow attributable to the project for December  
15 through April and increases in flow attributable to the project during May ranging from 6% to 13%  
16 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). The project-related increases in  
17 flow in the Sacramento River at Red Bluff would have a beneficial effect on migration conditions.

18 These results indicate that project-related effects of Alternative 2A on flow consist of negligible  
19 effects (<5%), or small increases in flow that would have a beneficial effect on migration in the  
20 Sacramento River at Red Bluff, but that effects for Sacramento River at Rio Vista would consist  
21 primarily of reductions in flow, including during drier water years, for much of the macrophthalmia  
22 migration period that would adversely affect outmigrating macrophthalmia.

#### 23 ***Adults***

24 For the Sacramento River at Red Bluff for the time-frame January to June (*Appendix 11C, CALSIM II*  
25 *Model Results utilized in the Fish Analysis*), effects of Alternative 2A on mean monthly flow indicate  
26 effects would be negligible (<5%) with small increases in flow (to 14%) during May and June for  
27 some water years. Increases in flow would have a beneficial effect on migration conditions.

#### 28 ***Feather River***

29 Macrophthalmia Comparisons for the Feather River at the confluence with the Sacramento River  
30 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*) indicate negligible (<5%)  
31 project-related effects or small increases in flow (to 9%) for December through March, and more  
32 substantial increases during April and May in some water year types (to 29%). Increases in mean  
33 monthly flow would be beneficial for migration conditions. Based on negligible effects and/or  
34 increases in flow that would be beneficial for migration, the project would not have adverse effects  
35 on macrophthalmia in the Feather River at the confluence.

#### 36 ***Adults***

37 For the Feather River at the confluence with the Sacramento River, January to June (*Appendix 11C,*  
38 *CALSIM II Model Results utilized in the Fish Analysis*), mean monthly flows under Alternative 2A are  
39 variable, with primarily negligible changes (<5%) for most months and water year types, with the

1 exception of fairly substantial increases for most water year types for April (10–20%), May (9–  
2 29%), and June (17–73%) that would have beneficial effects on migration conditions.

### 3 **American River**

4 Macrophthalmia Comparisons for the American River at the confluence with the Sacramento River  
5 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate negligible effects (<5%)  
6 or small to moderate increases in flows in all months, with more substantial increases during May  
7 (to 28%), with the exception of small decreases during March in dry (-6%) and critical (-7%) years  
8 that would not have biologically meaningful effects on migration conditions. The increases in flow  
9 would be beneficial for migration conditions.

10 Overall flow-related effects of Alternative 2A on outmigrating macrophthalmia are negligible (<5%)  
11 in the Sacramento River at Red Bluff, Feather River at the confluence with the Sacramento River, and  
12 American River at the confluence with the Sacramento River. Effects of Alternative 2A on flow in the  
13 Sacramento River at Rio Vista would consist of flow reductions, particularly in drier water year  
14 types, which would affect outmigrating macrophthalmia.

### 15 **Adults**

16 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
17 River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
18 indicate predominantly negligible effects (<5%) attributable to the project with the exception of  
19 increased flows in May (11–28%) and June (23–31%) which would enhance migration especially  
20 during drier water year types, and small decreases in flow (to -7%) during March in dry and critical  
21 years that would not have biologically meaningful effects on migration conditions.

22 Project-related effects of Alternative 2A on mean monthly flows during the Pacific lamprey adult  
23 migration period would consist of negligible effects (<5%) or increases in flow (up to 73%  
24 depending on the location, month, and water year type) that would not negatively affect adult  
25 migration in the rivers analyzed in a biological meaningful way. Project-related increases in flows  
26 would enhance migration, particularly in drier water year types such as for the American River.

27 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
28 substantially reduce the amount of suitable habitat and substantially interfere with the movement of  
29 fish. Flows in the Sacramento River at Rio Vista under Alternative 2A would be reduced relative to  
30 NAA, with persistent flow reductions to -31% throughout the migration period that would affect  
31 conditions for outmigrating macrophthalmia at that location. The degree to which this reduction  
32 would affect lamprey is unknown, but given the predominance of negligible effects in other  
33 locations, it is not likely that reduced flows at this location would affect the Pacific lamprey  
34 population. Effects of Alternative 2A in the other locations analyzed would consist primarily of  
35 negligible effects (<5%), infrequent, small decreases in flow (to -7%) that would not have  
36 biologically meaningful effects, and small to substantial (to 73%) increases in flow that would have  
37 beneficial effects on migration conditions.

38 **CEQA Conclusion:** In general, the effect of Alternative 2A on Pacific lamprey migration conditions  
39 would be negligible relative to the Existing Conditions.

1 **Sacramento River**

2 Macrophthalmia Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista  
3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for  
4 Alternative 2A relative to Existing Conditions indicate reductions in flow ranging from -5% to -48%  
5 in most water years for each of these months. These results indicate that effects of Alternative 2A on  
6 flow would have negative effects on outmigrating macrophthalmia in the Sacramento River.  
7 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*  
8 *in the Fish Analysis*) indicate negligible (<5%) effects or small increases or decreases in flow (to  
9 11%) that would not have biologically meaningful effects on migration conditions. Exceptions  
10 include a decrease in flow of -15% during May in wet years when flow reductions would not be as  
11 critical for migration conditions, and an increase of 16% during May in dry years that would have  
12 beneficial effects on migration. Therefore, Alternative 2A would not have biologically meaningful  
13 negative effects on outmigrating macrophthalmia at this location.

14 **Adults**

15 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*  
16 *Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from  
17 January through June indicate that for most months and water year types, flows under Alternative  
18 2A would be similar to (<5% difference) flows under Existing Conditions, with infrequent  
19 occurrences of small-scale (to 13%) increases or decreases in flow that would not have biologically  
20 meaningful effects on migration conditions. Exceptions include a slightly greater reduction in flow  
21 during May in wet years (-15%) when effects of flow reductions would be less critical for migration,  
22 and slightly greater increases in flow during May in dry years (16%) and during June in above  
23 normal years (21%) that would have beneficial effects on migration. Therefore, effects of Alternative  
24 2A consist of negligible effects or increases in flow that would have beneficial effects, and small  
25 reductions in flow that would not have biologically meaningful effects.

26 **Feather River**

27 Macrophthalmia Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model*  
28 *Results utilized in the Fish Analysis*) for December to May indicate variable effects by month and  
29 water year type, with increases in flow during December in above normal and below normal years  
30 (to 11%) and decreases in wet and critical years (to -31%), generally increases in flow during  
31 January through March in wetter years (to 20%) and decreases during some drier water year types  
32 (to -18%), and negligible effects or increases in flow (to 24%) during April and May except for a  
33 decrease (-24%) during May in wet years. Increases in flow would have beneficial effects on  
34 migration conditions, and decreases in wetter water years would not have significant effects on  
35 migration. Based on this limited occurrence of flow decreases at times that would be most critical  
36 for migration, and the prevalence of negligible effects or flow increases for most of the migration  
37 period, effects of Alternative 2A on flows would not have biologically meaningful effects on  
38 macrophthalmia migration in the Feather River.

39 **Adults**

40 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento  
41 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
42 indicate variable effects of Alternative 2A depending on the month and water year type, with  
43 primarily negligible effects (<5%) and small increases or decreases in flow (to about 13%) that

1 would not have biologically meaningful effects on migration conditions, with the exception of more  
2 substantial increases in flow during February in wet years (20%), March in above normal years  
3 (14%), April in dry years (19%), May in below normal years (24%), and June in above normal (51%)  
4 and below normal (58%) years. These flow increases would have a beneficial effect on migration  
5 conditions. There would be more substantial decreases in flow during March in below normal years  
6 (-18%) and during May in wet years (-24%) when effects of flow reduction on migration would be  
7 less critical. These flow reductions are isolated occurrences of relatively small magnitude and would  
8 therefore not have biologically meaningful effects on migration conditions. Therefore, effects of  
9 Alternative 2A on flow would not affect migration conditions in the Feather River.

#### 10 **American River**

11 Macrophthalmia Comparisons for the American River at the confluence with the Sacramento River  
12 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate  
13 negligible effects (<5%) or decreases in flow during December and April, increases in flow during  
14 January through March for some wetter water year types (to 27%) and decreases for some drier  
15 water year types (to -18%), and decreases to -26% during May in all water year types except dry  
16 (increase of 16%). Decreases in drier water years for December through March and May encompass  
17 much of the migration period and would affect macrophthalmia migration conditions for that time-  
18 frame (particularly critical years).

19 Overall conclusions are that impacts of Alternative 2A on mean monthly flows during the Pacific  
20 lamprey macrophthalmia migration period, December to May, would not affect migration conditions  
21 in the Sacramento River at Red Bluff and the Feather River, but would affect conditions in the  
22 Sacramento River at Rio Vista and in the American River during drier water years.

#### 23 **Adults**

24 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
25 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
26 indicate variable effects of Alternative 2A depending on the month and water year type, with  
27 meaningful changes in flow ( $\pm$ >5%) consisting of increases up to 27% (February, above normal  
28 years) that would have beneficial effects on migration conditions, and decreases to -18% in drier  
29 years. There would be primarily negligible effects (<5%) or small decreases (to -9%) during April.  
30 There would be decreases (to -26%) in all but critical years (increase of 16%) during May, and  
31 decreases during June in wet (-27%) and critical (-36%) years with increases (to 24%) in the  
32 remaining water years. Conclusions are that effects of Alternative 2A consist of variable effects on  
33 flow and predicted flow reductions would not have biologically meaningful effects on river lamprey  
34 macrophthalmia migration based on the magnitude of the decreases and infrequent or isolated  
35 occurrences.

#### 36 **Summary of CEQA Conclusion**

37 Collectively, these results indicate that the impact is not significant because it would not  
38 substantially reduce the amount of suitable habitat or substantially interfere with the movement of  
39 fish, and no mitigation is necessary. Effects of Alternative 2A compared to Existing Conditions  
40 during the January to June adult Pacific lamprey migration period consist predominantly of  
41 negligible effects (<5%), increases in flow, or small, isolated occurrences of decreases in flow for  
42 some water year types that would not have biologically meaningful effects on migration conditions.  
43 Flows at Rio Vista would decrease for much of the period. However, the degree to which this

1 reduction would affect lamprey is unknown, but given the predominance of negligible effects in  
2 other locations, it is not likely that reduced flows at this location would affect the Pacific lamprey  
3 population.

#### 4 **Restoration Measures (CM2, CM4–CM7, and CM10)**

5 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
6 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
7 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of  
8 restoration measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169  
9 through AQUA-171) also appropriately characterize effects under Alternative 2A.

10 The following impacts are those presented under Alternative 1A that are identical for Alternative  
11 2A.

#### 12 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

#### 13 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific** 14 **Lamprey**

#### 15 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

16 *NEPA Effects:* All three of these impact mechanisms have been determined to result in no adverse  
17 effects on Pacific lamprey for NEPA purposes.

18 *CEQA Conclusion:* All three of these impact mechanisms would be considered less than significant  
19 on Pacific lamprey, for the reasons identified for Alternative 1A, and no mitigation is required.

#### 20 **Other Conservation Measures (CM12–CM19 and CM21)**

21 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
22 differences in other conservation-related fish effects are anticipated anywhere in the affected  
23 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish  
24 effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impact  
25 AQUA-172 through AQUA-180) also appropriately characterize effects under Alternative 2A.

26 The following impacts are those presented under Alternative 1A that are identical for Alternative  
27 2A.

#### 28 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

#### 29 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey** 30 **(CM13)**

#### 31 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

#### 32 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey** 33 **(CM15)**

#### 34 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

1 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

2 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

3 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

4 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
5 **Lamprey (CM21)**

6 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
7 adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified  
8 for Alternative 1A.

9 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
10 less than significant, or beneficial on Pacific lamprey, for the reasons identified for Alternative 1A,  
11 and no mitigation is required.

12 **River Lamprey**

13 **Construction and Maintenance of CM1**

14 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

15 The potential effects of construction of the water conveyance facilities on river lamprey would be  
16 similar to those described for Alternative 1A (Impact AQUA-181) except that Alternative 2A could  
17 potentially include two different intakes than under Alternative 1A. This would convert about  
18 11,350 lineal feet of existing shoreline habitat into intake facility structures and would require about  
19 26 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal  
20 feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
21 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
22 of contaminated sediments would be similar to Alternative 1A and the same environmental  
23 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
24 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
25 effects.

26 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and  
27 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
28 not be adverse for river lamprey.

29 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-181, the impact of the construction  
30 of water conveyance facilities on river lamprey would be less than significant except for  
31 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and  
32 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

33 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
34 **of Pile Driving and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

1 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2 **and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

4 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

5 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
6 Alternative 2A would be the same as those described for Alternative 1A (see Impact AQUA-182). As  
7 concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse for river lamprey.

8 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-182 for lamprey, the impact of the  
9 maintenance of water conveyance facilities on river lamprey would be less than significant and no  
10 mitigation is required.

11 **Water Operations of CM1**

12 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

13 The potential entrainment impacts of Alternative 2A on river lamprey would be the same as  
14 described above for Alternative 1A (Impact AQUA-183).

15 **NEPA Effects:** The analysis of river lamprey entrainment at the SWP/CVP south Delta facilities is  
16 combined with the analysis of Pacific lamprey because the salvage facilities do not distinguish  
17 between the two lamprey species. Like Alternative 1A (Impact AQUA-3), Alternative 2A is expected  
18 to substantially reduce average annual entrainment of lamprey, estimated by salvage density, by  
19 about 59–60% (Table 11-2A-84) averaged across all years compared to NAA. Overall, Alternative 2A  
20 would not have adverse effects on lamprey.

21 **CEQA Conclusion:** As described above, annual entrainment losses of juvenile green sturgeon would  
22 be decreased under Alternative 2A by approximately 60% compared to Existing Conditions (Table  
23 11-2A-84). At the north Delta facilities and the alternate NBA intake, the screened intakes as  
24 designed would exclude this species. Decommissioning agricultural diversions would slightly reduce  
25 potential entrainment. Impacts of water operations on entrainment of river lamprey are considered  
26 less than significant and may be beneficial; no mitigation is required.

27 **Table 11-2A-84. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for**  
28 **Alternative 2A<sup>a</sup>**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
All Years	-2,044 (-60%)	-1,939 (-59%)

<sup>a</sup> Number of fish lost, based on non-normalized data, for all months.

29  
30 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
31 **River Lamprey**

32 In general, Alternative 2A would not affect the quantity and quality of river lamprey spawning  
33 habitat relative to NAA.

1 Flow-related impacts to river lamprey spawning habitat were evaluated by estimating effects of flow  
 2 alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames  
 3 for river lamprey incorporated into the analysis. Lower flows can reduce the instream area available  
 4 for spawning and rapid reductions in flow can dewater redds leading to mortality. The same  
 5 locations were analyzed as for Pacific lamprey: the Sacramento River at Keswick and Red Bluff,  
 6 Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, and American River at  
 7 Nimbus Dam and at the confluence with the Sacramento River. River lamprey spawn in these rivers  
 8 between February and June so flow reductions during those months have the potential to dewater  
 9 redds, which could result in incomplete development of the eggs to ammocoetes (the larval stage).

10 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-  
 11 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning  
 12 location suitability characteristics (e.g., depth, velocity, substrate) of river lamprey are not  
 13 adequately described to employ a more formal analysis such as a weighted usable area analysis.  
 14 Therefore, as described for Pacific lamprey, there is uncertainty that these values represent actual  
 15 redd dewatering events, and results should be treated as rough estimates of flow fluctuations under  
 16 each model scenario. Results were expressed as the number of cohorts exposed to dewatering risk  
 17 and as a percentage of the total number of cohorts anticipated in the river based on the applicable  
 18 time-frame, February to June.

19 Flows in all rivers evaluated indicated increases in redd cohorts exposed would only occur in the  
 20 Feather River (9% increase) (Table 11-2A-85). All other locations would experience no change (0%)  
 21 or negligible change ( $\pm 5\%$ ) attributable to the project. The increased risk for the Feather River is  
 22 small (9%) and would not cause a biologically meaningful effect on spawning success.

23 **Table 11-2A-85. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**  
 24 **Cohorts<sup>a</sup>**

Location	Comparison <sup>b</sup>	EXISTING CONDITIONS	
		vs. A2A_LL1	NAA vs. A2A_LL1
Sacramento River at Keswick	Difference	4	1
	Percent Difference	13%	3%
Sacramento River at Red Bluff	Difference	2	0
	Percent Difference	5%	0%
Trinity River downstream of Lewiston	Difference	-4	-2
	Percent Difference	-6%	-3%
Feather River Below Thermalito Afterbay	Difference	-5	5
	Percent Difference	-7%	9%
American River at Nimbus	Difference	10	1
	Percent Difference	18%	2%
American River at Sacramento River confluence	Difference	16	-1
	Percent Difference	27%	-1%

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

<sup>b</sup> Positive values indicate a higher value in Alternative 2A than in EXISTING CONDITIONS or NAA).

1 River lamprey generally spawn between February and June (Beamish 1980, Moyle 2002). Using  
2 Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water  
3 temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same  
4 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...  
5 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for  
6 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,  
7 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both  
8 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.  
9 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM  
10 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from  
11 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods  
12 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data  
13 from the Bureau’s temperature model. Each individual day or month starts a new “egg cohort” such  
14 that there are 12,320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid  
15 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using  
16 monthly data over the same period. The incubation periods used in this analysis are conservative  
17 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of  
18 the monthly average time step is limited because the extreme temperatures are masked; however,  
19 no better analytical tools are currently available for this analysis. Spawning locations of river  
20 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is  
21 thought to spawn in each river.

22 For both thresholds, there would be few differences in egg cohort exposure between NAA and  
23 Alternative 2A among all sites (Table 11-2A-86). Differences of 20 cohorts in the Sacramento River  
24 at Hamilton City are negligible to the population considering the total number of cohorts is 12,320.  
25 In the Feather River below Thermalito Afterbay, there would be 10 more cohorts (26% increase)  
26 exposed to the 71.6°F threshold under Alternative 2A relative to NAA, although differences at the  
27 77°F threshold would be negligible. In addition, there would be no differences between NAA and  
28 Alternative 2A in egg exposure at the Fish Barrier Dam in the Feather River. Overall, except at one  
29 location in the Feather River for the more conservative threshold temperature (71.6°F), these  
30 results indicate that there would be no differences in egg exposure to elevated temperatures under  
31 Alternative 2A.

1 **Table 11-2A-86. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg**  
2 **Cohort Temperature Exposure**

Location	EXISTING CONDITIONS vs. A2A_LL1	NAA vs. A2A_LL1
<b>71.6°F Threshold</b>		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	315 (NA)	-8 (-2%)
Trinity River at Lewiston	0 (NA)	-1 (-100%)
Trinity River at North Fork	4 (NA)	-1 (-20%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	39 (433%)	10 (26%)
American River at Nimbus	21 (420%)	-4 (-13%)
American River at Sacramento River Confluence	43 (154%)	-11 (-13%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	-1 (-100%)	-35 (-100%)
<b>77°F Threshold</b>		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	56 (NA)	20 (56%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	4 (NA)	2 (100%)
American River at Nimbus	5 (NA)	1 (25%)
American River at Sacramento River Confluence	7 (NA)	1 (17%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F and 77°F during February to June on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

3  
4 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does  
5 not have the potential to substantially reduce rearing habitat or substantially reduce the number of  
6 fish as a result of ammocoete mortality. Alternative 2A would cause minor effects to river lamprey  
7 redd dewatering and exposure to elevated water temperatures that would not be substantial.

8 **CEQA Conclusion:** In general, Alternative 2A would not affect the quantity and quality of river  
9 lamprey spawning habitat relative to the Existing Conditions due to increases in exposure to critical  
10 water temperatures in the Feather River and moderate increases in dewatering risk from flow  
11 reductions in the Sacramento River and the American River.

12 Lower flows can reduce the instream area available for spawning and rapid reductions in flow can  
13 dewater redds leading to mortality. Effects of Alternative 2A on flow reductions during the river  
14 lamprey spawning period from February to June in the Sacramento River and American River

1 consist of increases in river lamprey redd cohort dewatering risk relative to Existing Conditions  
2 (Table 11-2A-85). Changes would be most substantial for the American River (increased risk of  
3 dewatering exposure to 10 cohorts or 18% at Nimbus Dam, and 16 cohorts or 27% at the  
4 confluence). For the Trinity River there are 4 fewer redd cohorts (-6%), and for the Feather River  
5 there are five fewer redd cohorts (-7%), predicted to experience a month-over-month change in  
6 flow of greater than 50% for Alternative 2A relative to Existing Conditions.

7 In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative  
8 2A would be similar to or lower than those under NAA (Table 11-2A-86). Biologically meaningful  
9 exceptions includes the Trinity River at Lewiston, Feather River below Thermalito Afterbay and the  
10 Sacramento River at Hamilton City for the 71.6°F threshold, and the Feather River below Thermalito  
11 Afterbay for the 77°F threshold. In all cases, there would be another location within the river that  
12 would have similar or lower exceedances under Alternative 2A.

### 13 **Summary of CEQA Conclusion**

14 Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between  
15 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
16 alternative could substantially reduce suitable spawning habitat and substantially reduce the  
17 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above.  
18 Alternative 2A would reduce river lamprey survival due to increases in water temperature in the  
19 Feather River below Thermalito Afterbay relative to the Existing Conditions. Increased water  
20 temperatures would increase stress and reduce survival of lamprey ammocoetes. Alternative 2A  
21 would cause minor impacts on river lamprey redd dewatering that would be less than significant.

22 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
23 change, future water demands, and implementation of the alternative. The analysis described above  
24 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
25 the alternative from those of sea level rise, climate change and future water demands using the  
26 model simulation results presented in this chapter. However, the increment of change attributable  
27 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
28 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
29 implementation period, which does include future sea level rise, climate change, and water  
30 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
31 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
32 effect of the alternative from those of sea level rise, climate change, and water demands.

33 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
34 term implementation period and Alternative 2A indicates that flows in the locations and during the  
35 months analyzed above would generally be similar between Existing Conditions during the LLT and  
36 Alternative 2A. This indicates that the differences between Existing Conditions and Alternative 2A  
37 found above would generally be due to climate change, sea level rise, and future demand, and not  
38 the alternative. As a result, the CEQA conclusion regarding Alternative 2A, if adjusted to exclude sea  
39 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
40 result in a significant impact on spawning habitat for river lamprey. This impact is found to be less  
41 than significant and no mitigation is required.

**Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

In general, Alternative 2A would not affect the quantity and quality of river lamprey rearing habitat relative to NAA due to increased exposure to critical water temperatures in the Feather River below Thermalito Afterbay. There would be a beneficial effect from substantial decreases in exposure to flow reductions in the American River, but negligible effects on stranding risk in the other locations analyzed.

Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Effects of Alternative 2A on flow were evaluated in the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus Dam and at the confluence with the Sacramento River. As for Pacific lamprey, the analysis of river lamprey ammocoete stranding was conducted by analyzing a range of month-over-month flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of ammocoetes was assumed to be born every month during their spawning period (February through June) and spend 5 years rearing upstream. Therefore, a cohort was considered stranded if at least one month-over-month flow reduction was greater than the flow reduction at any time during the period. Comparisons of flow reductions for Alternative 2A relative to NAA for the Sacramento River at Keswick (Table 11-2A-87) predicted either no effect (0%), negligible effects ( $\pm 5\%$ ), or small decreases (-13%) in the occurrence of flow reductions attributable solely to the project, which would have beneficial effects on rearing success.

**Table 11-2A-87. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	2	0
-60%	5	2
-65%	4	3
-70%	-2	-2
-75%	-8	-2
-80%	-4	-13
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-2A-88) provided similar conclusions, with slightly more variability in results. Alternative 2A compared to NAA indicated no change (0%), negligible increases (<5%), and small decreases (-3 to -12%) attributable to the project for different flow reduction categories. There is a single flow reduction category, 60%, that would experience a small increase in occurrence attributable to the project, 6%. Based on the

1 general decrease in frequency of most of the flow reduction categories, the small increase (6%)  
2 predicted for 60% flow reduction event would not have biologically meaningful effects on rearing  
3 success.

4 **Table 11-2A-88. Percent Difference between Model Scenarios in the Number of River Lamprey**  
5 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
6 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	6	3
-60%	13	6
-65%	-2	-3
-70%	10	1
-75%	7	-12
-80%	6	-4
-85%	100 [ 0 to 50]	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

7  
8 Comparisons for the Trinity River indicate increases in occurrence of 75 through 90% flow  
9 reductions under Alternative 2A relative to NAA (Table 11-2A-89) indicates no effect (0%) or  
10 (negligible changes ±5%) attributable to the project.

11 **Table 11-2A-89. Percent Difference between Model Scenarios in the Number of River Lamprey**  
12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	26	-5
-80%	39	0
-85%	28	-2
-90%	59	4

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

13  
14 In the Feather River, there would be no difference (0%) or reductions in the occurrence of flow  
15 reductions between 50-90% (Table 11-2A-90).

1 **Table 11-2A-90. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
 3 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	-1	-1
-80%	-12	-6
-85%	-29	-46
-90%	-62	-32

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

4  
 5 Flow reduction comparisons for the American River at Nimbus Dam (Table 11-2A-91) and at the  
 6 confluence with the Sacramento River (Table 11-2A-92) indicated no effect (0%), negligible  
 7 increases (<5%), or substantial decreases (to -55%) attributable to the project, with an increase of  
 8 15% for only one flow reduction category, 80% flow reduction, for the confluence. Based on the  
 9 general decrease in frequency of most of the flow reduction categories, the small increase (15%)  
 10 predicted for a single flow reduction category (80%) would not have biologically meaningful effects.

11 **Table 11-2A-91. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
 13 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	3	-1
-65%	4	-3
-70%	48	-6
-75%	131	2
-80%	312	-13
-85%	388 [25 to 122]	-13
-90%	36	-55

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

14

1 **Table 11-2A-92. Relative Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
-50%	0	0
-55%	0	0
-60%	3	-1
-65%	4	-1
-70%	20	-3
-75%	52	-1
-80%	289 [71-276]	15
-85%	290 [50-195]	-9
-90%	200 [25-75]	-35

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 2A.

4  
 5 River lamprey generally spawn between February and June (Beamish 1980, Moyle 2002). Using  
 6 Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water  
 7 temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same  
 8 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...  
 9 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for  
 10 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,  
 11 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both  
 12 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.  
 13 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM  
 14 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from  
 15 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods  
 16 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data  
 17 from the Bureau’s temperature model. Each individual day or month starts a new “egg cohort” such  
 18 that there are 12,320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid  
 19 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using  
 20 monthly data over the same period. The incubation periods used in this analysis are conservative  
 21 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of  
 22 the monthly average time step is limited because the extreme temperatures are masked; however,  
 23 no better analytical tools are currently available for this analysis. Spawning locations of river  
 24 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is  
 25 thought to spawn in each river.

26 In the Sacramento River at Hamilton City, there would be 685 more cohorts (could not calculate  
 27 relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 2A  
 28 relative to Existing Conditions, although this represents a small proportion (6%) of the total number  
 29 of cohorts evaluated (12,320 cohorts) (Table 11-2A-93). Therefore, would not be biologically  
 30 meaningful. There would be 15 more (30% increase) and 60 more (19% increase) cohorts exposed  
 31 to elevated temperatures in the Trinity River at Lewiston and in the Feather River below Thermalito  
 32 Afterbay, respectively. These would also be small proportions of total cohorts and, therefore, would

1 not be biologically meaningful. There are no other increases in any rivers at the 71.6°F temperature  
2 threshold and no biologically meaningful increases at the 77°F temperature threshold.

3 **Table 11-2A-93. Differences (Percent Differences) between Model Scenarios in River Lamprey**  
4 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F and 77°F**  
5 **in at Least One Month**

Location	EXISTING CONDITIONS	
	vs. A2A_LLT	NAA vs. A2A_LLT
<b>71.6°F Threshold</b>		
Sacramento River at Keswick <sup>b</sup>	1,218 (NA)	0 (0%)
Sacramento River at Hamilton City <sup>b</sup>	10,180 (NA)	685 (7%)
Trinity River at Lewiston	65 (NA)	15 (30%)
Trinity River at North Fork	135 (NA)	-25 (-16%)
Feather River at Fish Barrier Dam	0 (NA)	-25 (-100%)
Feather River below Thermalito Afterbay	190 (100%)	60 (19%)
American River at Nimbus	240 (267%)	-5 (-1%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	25 (NA)	0 (0%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
<b>77°F Threshold</b>		
Sacramento River at Keswick <sup>b</sup>	0 (NA)	0 (NA)
Sacramento River at Hamilton City <sup>b</sup>	0 (NA)	0 (NA)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	90 (NA)	50 (125%)
American River at Nimbus	175 (NA)	-45 (-20%)
American River at Sacramento River Confluence	235 (470%)	5 (2%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Positive values indicate a higher value in the preliminary proposal than in EXISTING CONDITIONS or NAA.

<sup>b</sup> Based on daily data; all other locations use monthly data; 1922–2003.

6

7 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does  
8 not have the potential to substantially reduce rearing habitat or substantially reduce the number of  
9 fish as a result of ammocoete mortality. Alternative 2A would not affect river lamprey ammocoete  
10 stranding relative to the NEPA baseline. Further, increases in exposure to water temperatures under  
11 Alternative 2A would not be biologically meaningful.

12 **CEQA Conclusion:** In general, Alternative 2A would not affect the quantity and quality of river  
13 lamprey rearing habitat relative to the Existing Conditions

14 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can  
15 strand ammocoetes leading to mortality. Comparisons of Alternative 2A to Existing Conditions for

1 the Sacramento River at Keswick indicate decreases (to -8%) or negligible increases (<5%) in the  
2 occurrence of flow reductions for all flow reduction categories (Table 11-2A-87) with the exception  
3 of a small increase (6%) in month-over-month flow reductions of 60% and a 44% increase in  
4 reductions of 85%. Comparisons for the Sacramento River at Red Bluff indicate slightly more  
5 variable results with no effect (0%) or negligible effects (<5%) for all flow reduction categories  
6 except for small increases (6% to 13%) in the 55%, 70% through 80% flow reductions, and a more  
7 substantial increase (100%, or from 0 to 50 cohorts) in the 85% flow reduction category (Table 11-  
8 2A-88).

9 Comparisons for the Trinity River indicated no effect (0%) for flow reduction categories from 50%  
10 to 70%, and increases ranging from 26% to 59% for the higher flow reduction categories (Table 11-  
11 2A-89).

12 Comparisons for the Feather River indicated no effect or reductions in frequency of occurrence for  
13 all flow reduction categories (Table 11-2A-90).

14 Comparisons for the American River at Nimbus Dam (Table 11-2A-91) and at the confluence with  
15 the Sacramento River (Table 11-2A-92) indicated increased chance of occurrence of flow reductions  
16 between 70 and 90% for Alternative 2A compared to Existing Conditions; meaningful (>5%)  
17 predicted increases are from 48 to 388% (increase in cohorts exposed from 25 to 122) for Nimbus  
18 Dam and from 20 to 290% (increase in cohorts exposed from 50 to 195) for the confluence.

19 The number of ammocoete cohorts exposed to 71.6°F under Alternative 2A would be substantially  
20 higher than those under Existing Conditions in most locations examined (Table 11-A1-93). The  
21 number of ammocoete cohorts exposed to 77°F under Alternative 2A would be similar at all  
22 locations except the Feather River below Thermalito Afterbay and at both locations in the American  
23 River, at which exposure would increase by 90 to 235 cohorts.

#### 24 **Summary of CEQA Conclusion**

25 The results of the Impact AQUA-185 CEQA analysis indicate that that the difference between the  
26 CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
27 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
28 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. There would be  
29 substantial increases in stranding risk in the Trinity and American Rivers under Alternative 2A  
30 relative to the Existing Conditions. Increased stranding risk in these rivers would increase the risk of  
31 desiccation and reduce survival of ammocoete cohorts. Additionally, the risk of exposure to elevated  
32 water temperatures would substantially increase under Alternative 2A relative to the Existing  
33 Conditions. Increased water temperatures would increase stress and reduce survival of lamprey  
34 ammocoetes.

35 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
36 change, future water demands, and implementation of the alternative. The analysis described above  
37 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
38 the alternative from those of sea level rise, climate change and future water demands using the  
39 model simulation results presented in this chapter. However, the increment of change attributable  
40 to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
41 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
42 implementation period, which does include future sea level rise, climate change, and water  
43 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
4 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
5 locations and during the months analyzed above would generally be similar between Existing  
6 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
7 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
8 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
9 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
10 therefore would not in itself result in a significant impact on rearing habitat for river lamprey. This  
11 impact is found to be less than significant and no mitigation is required.

### 12 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

13 In general, Alternative 2A would have negligible effects on river lamprey migration conditions  
14 relative to NAA due to negligible effects on mean monthly flows. There would be beneficial effects  
15 due to moderate increases in mean monthly flow for some months and water year types but these  
16 generally would be offset by flow reductions in other months.

#### 17 ***Macrophthalmia***

18 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once  
19 they reach the Delta. River lamprey migration generally occurs September through November  
20 (USFWS unpubl. data). The effects of water operations on seasonal migration flows for river lamprey  
21 macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration  
22 pathways of river lamprey during the likely migration period (September through November) were  
23 examined to predict how Alternative 2A may affect migration flows for outmigrating macrophthalmia.

24 Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with  
25 the Sacramento River, and the American River at the confluence with the Sacramento River.

#### 26 ***Sacramento River***

27 Comparisons for the Sacramento River at Red Bluff for September through November indicate  
28 variable effects of Alternative 2A depending on the month and the water year type. Alternative 2A  
29 indicates variable effects, with project-related increases (9% to 17% in dry and critical years) that  
30 would have beneficial effects on migration conditions and decreases (-5% and -15% in above  
31 normal and below normal years) in September, primarily negligible effects (<5%) in October, and  
32 decreases in flows for all but critical years (with <5% difference) in November (-11 to -17%).  
33 Decreases in wetter years in September would less detrimental because flows are higher; the  
34 increases in drier water years would be beneficial for outmigration. Decreases (to 17%) for all but  
35 critical years in November would affect migration conditions during that month, which is the last  
36 month in the relatively short migration period.

#### 37 ***Feather River***

38 Comparisons for the Feather River at the confluence with the Sacramento River for September  
39 through November indicate decreases in flow during wetter years in September (-10, -19, and -33%  
40 for wet, above normal, below normal, respectively) and increases in flow during drier years (6 and  
41 19% for dry and critical years, respectively). The increases in flow during dry and critical years for

1 September would have a positive effect on migration when flow conditions are most critical. There  
2 would also be project-related increases in flow during October in all water years, ranging from 9 to  
3 32% depending on water year type. Project-related effects during November would be negligible  
4 (<5%) in all water year types with the exception of a small decrease in mean monthly flow (-8%)  
5 during above normal years that would not have biologically meaningful effects. These results  
6 indicate Alternative 2A would not affect migration in the Feather River.

#### 7 *American River*

8 Comparisons for the American River at the confluence with the Sacramento River for September  
9 through November indicate decreased flows during September in wetter water years (to -19%) and  
10 negligible effects (<5%) in drier water years when flow effects would be more detrimental for  
11 migration, increases in mean monthly flows during October in drier water year types (10 and 15%  
12 for below normal and dry years), and negligible project-related changes during November except for  
13 small changes in dry (+6%) and critical (-9%) water years. These results indicate Alternative 2A  
14 would not affect migration conditions in the American River.

15 Overall conclusions are that, with some variation in results by location, month, and water year type,  
16 Alternative 2A would generally not have biologically meaningful effects on macrophthalmia migration  
17 based on negligible effects (<5%), decreases in flow during wetter water year types that would not  
18 have biologically meaningful effects, and increases in flow during drier water years that would have  
19 a beneficial effect on migration.

#### 20 **Adults**

21 Effects of Alternative 2A on flow during the adult migration period, September through November,  
22 would be the same as described for the macrophthalmia migration period, September through  
23 November, above.

24 **NEPA Effects:** Collectively, these results indicate that is not adverse because it would not  
25 substantially reduce the amount of suitable habitat or substantially interfere with the movement of  
26 fish. Flows under Alternative 2A would not be reduced from NAA in any waterway analyzed that  
27 would affect river lamprey macrophthalmia or adults in a biologically meaningful way. There would  
28 be small to moderate increases in mean monthly flow for some months and water year types that  
29 would have beneficial effects on migration conditions.

30 **CEQA Conclusion:** In general, under Alternative 2A water operations, the quantity and quality of  
31 suitable migration habitat for river lamprey would not be affected relative to the CEQA baseline.

#### 32 **Macrophthalmia**

##### 33 *Sacramento River*

34 Comparisons for the Sacramento River at Red Bluff for September through November indicate  
35 variable effects of Alternative 2A during September, with increases in mean monthly flow for wetter  
36 water year types (38 to 55%) that would have beneficial effects on migration conditions, and  
37 decreases for drier water year types (-13 and -17% for below normal and dry years, respectively).  
38 Alternative 2A would have negligible effects ( $\pm$ <5%) for October with the exception of increased  
39 flows (10%) during dry years. Alternative 2A would result in small decreases in mean monthly flows  
40 compared to Existing Conditions for all water year types in November (-6 to -13%). Persistent small

1 to moderate reductions in flow in drier water years for two of the three months in the migration  
2 period would affect migration conditions in the Sacramento River.

### 3 *Feather River*

4 Comparisons for the Feather River at the confluence with the Sacramento River for September  
5 through November indicate variable results by month and water year type, with increases for wetter  
6 years and decreases in drier years in September, variable results with primarily increases in drier  
7 years (13 and 15% for dry and critical years, respectively) in October that would have a small  
8 beneficial effect on migration, and primarily decreases for most water year types in November (-6 to  
9 -20%). Decreased mean monthly flows in September and November during drier water years would  
10 affect migration conditions; increases in these water year types in September would have a  
11 beneficial effect.

### 12 *American River*

13 Comparisons for the American River at the confluence with the Sacramento River for September  
14 through November indicate reductions in flow for most months and most water year types, ranging  
15 from -6 to -56%, with the exception of a 20% increase in mean monthly flow during October for  
16 below normal water years. There would also be negligible decreases (<5%) for October flows during  
17 dry years. The predominance of decreased flows for Alternative 2A compared to Existing Conditions  
18 would affect migration conditions, with substantial decreases for dry and critical years in September  
19 (-42 and -56%, respectively) and November (-33 and -28%, respectively).

20 Overall, these results indicate that Alternative 2A would cause decreases in mean monthly flow  
21 during all or portions of the river lamprey macrophthalmia migration period in the Sacramento River  
22 (to -17% in dry years), Feather River (to -20%), and American River (to -56%).

### 23 **Adults**

24 Effects of Alternative 2A on flow during the adult migration period, September through November,  
25 would be the same as described for the macrophthalmia migration period, September through  
26 November, above.

### 27 **Summary of CEQA Conclusion**

28 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between  
29 the CEQA baseline and Alternative 2A could be significant because, under the CEQA baseline, the  
30 alternative could substantially reduce the amount of suitable habitat and substantially interfere with  
31 the movement of fish, contrary to the NEPA conclusion set forth above. Reductions in flows during  
32 the macrophthalmia and adult migration periods would reduce migration ability of both life stages.  
33 For macrophthalmia, reduced migration ability would increase straying risk and delay initiation of  
34 the oceanic life stage. For adults, reduced flows would reduce the ability to sense olfactory cues if  
35 adults use such cues to return to natal spawning grounds.

36 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
37 change, future water demands, and implementation of the alternative. The analysis described above  
38 comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
39 the alternative from those of sea level rise, climate change and future water demands using the  
40 model simulation results presented in this chapter. However, the increment of change attributable  
41 to the alternative is well informed by the results from the NEPA analysis, which found this effect to

1 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
2 implementation period, which does include future sea level rise, climate change, and water  
3 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
4 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
5 effect of the alternative from those of sea level rise, climate change, and water demands.

6 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
7 term implementation period and Alternative 2A indicates that flows and reservoir storage in the  
8 locations and during the months analyzed above would generally be similar between Existing  
9 Conditions during the LLT and Alternative 2A. This indicates that the differences between Existing  
10 Conditions and Alternative 2A found above would generally be due to climate change, sea level rise,  
11 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative  
12 2A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
13 therefore would not in itself result in a significant impact on migration conditions for river lamprey.  
14 This impact is found to be less than significant and no mitigation is required.

### 15 **Restoration Measures (CM2, CM4–CM7, and CM10)**

16 Alternative 2A has the same restoration measures as Alternative 1A. Because no substantial  
17 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
18 under Alternative 2A compared to those described in detail for Alternative 1A, the fish effects of  
19 restoration measures described for river lamprey under Alternative 1A (Impact AQUA-187 through  
20 AQUA-189) also appropriately characterize effects under Alternative 2A.

21 The following impacts are those presented under Alternative 1A that are identical for Alternative  
22 2A.

### 23 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

### 24 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River** 25 **Lamprey**

### 26 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

27 **NEPA Effects:** All three of these impact mechanisms have been determined to result in no adverse  
28 effects on river lamprey for NEPA purposes.

29 **CEQA Conclusion:** All three of these impact mechanisms would be considered less than significant  
30 on river lamprey, for the reasons identified for Alternative 1A, and no mitigation is required.

### 31 **Other Conservation Measures (CM12–CM19 and CM21)**

32 Alternative 2A has the same other conservation measures as Alternative 1A. Because no substantial  
33 differences in other conservation-related fish effects are anticipated anywhere in the affected  
34 environment under Alternative 2A compared to those described in detail for Alternative 1A, the fish  
35 effects of other conservation measures described for river lamprey under Alternative 1A (Impact  
36 AQUA-190 through AQUA-198) also appropriately characterize effects under Alternative 2A.

37 The following impacts are those presented under Alternative 1A that are identical for Alternative  
38 2A.

1 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

2 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
3 **(CM13)**

4 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

5 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

6 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

7 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

8 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

9 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

10 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
11 **(CM21)**

12 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no  
13 adverse effect, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified  
14 for Alternative 1A.

15 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to  
16 less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A, and  
17 no mitigation is required.

## 18 **Non-Covered Aquatic Species of Primary Management Concern**

### 19 **Construction and Maintenance of CM1**

20 The effects of construction and maintenance of CM1 under Alternative 2A would be similar for all  
21 non-covered species; therefore, the analysis below is combined for all non-covered species instead  
22 of analyzed by individual species.

### 23 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered** 24 **Aquatic Species of Primary Management Concern**

25 Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water  
26 conveyance facilities on non-covered species of primary management concern. That discussion  
27 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
28 to the aquatic environment and aquatic species. The potential effects of the construction of water  
29 conveyance facilities under Alternative 2A would be similar to those described for Alternative 1A  
30 (see Alternative 1A, Impact AQUA-1) except that Alternative 2A could potentially include two  
31 different intakes than under Alternative 1A. This would convert about 11,350 lineal feet of existing  
32 shoreline habitat into intake facility structures and would require about 26 acres of dredge and  
33 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
34 would require 27.3 acres of dredging. The effects related to temporary increases in turbidity,  
35 accidental spills, underwater noise, in-water work activities, and disturbance of contaminated

1 sediments would be similar to Alternative 1A and the same environmental commitments and  
2 mitigation measures (described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
3 *Environmental Commitments*) would be available to avoid and minimize potential effects.  
4 Additionally, California bay shrimp would not be affected because they do not occur in the vicinity  
5 and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary  
6 distributions are upstream.

7 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and  
8 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
9 not be adverse for non-covered species of management concern.

10 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-199, the impact of the construction  
11 of the water conveyance facilities on non-covered aquatic species of primary management concern  
12 would be less than significant except for construction noise associated with pile driving.  
13 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce  
14 that noise impact to less than significant.

15 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
16 **of Pile Driving and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
18 Alternative 1A.

19 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
20 **and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
22 Alternative 1A.

23 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
24 **Aquatic Species of Primary Management Concern**

25 Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water  
26 conveyance facilities on non-covered species of primary management concern. That discussion  
27 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
28 to the aquatic environment and aquatic species. The potential effects of the construction of water  
29 conveyance facilities under Alternative 2A would be similar to those described for Alternative 1A  
30 (see Alternative 1A, Impact AQUA-2). California bay shrimp would not be affected because they do  
31 not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected  
32 because their primary distributions are upstream. Consequently, the effects would not be adverse.

33 **Water Operations of CM1**

34 The effects of water operations of CM1 under Alternative 2A include a detailed analysis of the  
35 following species:

- 36 ● Striped Bass
- 37 ● American Shad
- 38 ● Threadfin Shad
- 39 ● Largemouth Bass

- 1 • Sacramento tule perch
- 2 • Sacramento-San Joaquin roach – California species of special concern
- 3 • Hardhead – California species of special concern
- 4 • California bay shrimp

5 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
6 **Species of Primary Management Concern**

7 Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-  
8 covered species of primary management concern.

9 ***Striped Bass***

10 Striped bass spawn mostly upstream of the Delta in the Sacramento River, between Colusa and the  
11 Feather River confluence; however spawning can take place as far downstream as Isleton (Moyle  
12 2002). Limited spawning occurs in the south Delta and lower San Joaquin River. Striped bass eggs  
13 could be transported downstream from spawning grounds towards the proposed north Delta  
14 intakes. Although these intakes would be screened to exclude fish smaller than 15 mm, striped bass  
15 eggs or larvae that drift downstream would have the potential to be entrained. Similarly, the screens  
16 of the alternate NBA intake would be screened to exclude larger fish, but eggs and larvae would be  
17 exposed to entrainment.

18 At the south Delta facilities, entrainment peaks during the summer months, based on historical  
19 salvage. Entrainment losses under Alternative 2A would be expected to decrease compared to  
20 baseline conditions since exports are substantially reduced in the summer. This result is based on  
21 the assumption that striped bass entrainment is proportional to south Delta exports.

22 Striped bass may be vulnerable to entrainment at the new alternate NBA intake on the Sacramento  
23 River. Similar to the north Delta diversion intakes, the NBA alternate intake on the Sacramento River  
24 would be equipped with state-of-the-art fish screens that would exclude larger juveniles and adult  
25 striped bass, but would not exclude eggs and larvae.

26 Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile  
27 striped bass (Nobriga et al. 2004). These diversions are typically small and located on-shore, which  
28 may reduce the vulnerability of striped bass to entrainment to these diversions due to their pelagic  
29 nature. Reduction or consolidation of diversions from the ROA's (approximately 4–12% of  
30 diversions) would not increase entrainment and may provide a minor benefit. In addition,  
31 restoration activities as part of the conservation measures should increase the amount of habitat for  
32 young striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is  
33 that these habitat changes would result in at least a minor improvement in production of juvenile  
34 striped bass.

35 ***NEPA Effects:*** In summation, potential entrainment would increase for Sacramento River eggs and  
36 larvae that drift downstream past the north Delta intakes and the NBA alternative intake on the  
37 Sacramento River compared to baseline (no intake facilities), while entrainment of bass at the south  
38 Delta facilities would potentially decrease. Although egg and larval survival is correlated with  
39 striped bass young of year (YOY) production, the variability in egg and larval survival is dampened  
40 by a population bottleneck between YOY abundance and striped bass recruitment at three years of  
41 age (Kimmerer et al. 2000). Hence variations in striped bass survival rates during the first few

1 months of life are moderated by this bottleneck (Kimmerer et al. 2000). Therefore it would be  
2 expected that reductions in entrainment of juveniles and adults at the south Delta intakes would  
3 have a greater population impact than increases in entrainment at the proposed SWP/CVP north  
4 Delta intakes and the NBA intake. Furthermore, reductions in agricultural diversions may also  
5 reduce entrainment of striped bass. Overall, the effect on striped bass entrainment is not adverse.

6 **CEQA Conclusion:** The impact of water operations on entrainment of striped bass would be the  
7 same as described immediately above. The changes in entrainment under Alternative 2A would not  
8 substantially reduce the striped bass population when other conservation measures are taken into  
9 consideration. The impact would be less than significant and no mitigation would be required.

### 10 **American Shad**

11 The majority of American shad spawning occurs upstream of the Delta but some spawning is  
12 believed to occur in the Delta along the Sacramento River (Stevens 1966). American shad eggs stay  
13 suspended in the water column and may gradually drift downstream towards the proposed north  
14 delta intakes. The north Delta is also used as nursery habitat for American shad. The intakes of the  
15 north Delta diversion and the NBA intake would be screened, but small life stages (eggs and larvae)  
16 would have the potential to be entrained. Some larval American shad would be in the north Delta,  
17 but only a small fraction of the total larval population would encounter the proposed North Delta  
18 intakes when they are still vulnerable to entrainment.

19 At the SWP/CVP south Delta facilities, historical salvage of American shad was highest in the  
20 summer months but continued to be elevated through the fall months. American shad entrainment  
21 losses under Alternative 2A would decrease compared to baseline conditions due to reduced south  
22 delta exports for all months. Reduced south delta entrainment would also be expected to reduce  
23 predation loss associated with these facilities, especially within Clifton Court Forebay. Reduction or  
24 consolidation of agricultural diversions in ROA's would not increase entrainment.

25 **NEPA Effects:** Overall, the effect on American shad is not adverse, and would likely be slightly  
26 beneficial.

27 **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the  
28 same as described immediately above. The changes in entrainment under Alternative 2A would not  
29 substantially reduce the American shad population. The impact would be less than significant and  
30 no mitigation would be required.

### 31 **Threadfin Shad**

32 Threadfin shad are widely distributed throughout the Delta, however they are most abundant in the  
33 southeastern region of the Delta where areas of dense SAV in shallow water serve as important  
34 spawning and rearing habitat (Feyrer et al. 2009). The proposed SWP/CVP north delta intakes and  
35 alternate NBA intake would be located well upstream of this region, which would limit potential  
36 entrainment of shad eggs and larvae, and the intakes would be screened to avoid entrainment of  
37 juveniles and adults.

38 At the SWP/CVP south Delta facilities, historical salvage of threadfin shad peaks sharply in the  
39 summer months, with smaller peaks occurring in late fall and early winter. Threadfin shad  
40 entrainment losses would decrease due to reduced south Delta exports under Alternative 2A  
41 Additionally, reduced south delta entrainment is expected to reduce the amount of elevated  
42 predation loss associated with these facilities, especially within Clifton Court Forebay.

1 Agricultural diversions may be sources of entrainment for threadfin shad. Reduction or  
2 consolidation of these agricultural diversions under the Plan would decrease or have no impact on  
3 threadfin shad entrainment.

4 **NEPA Effects:** Overall, entrainment would be reduced, which would benefit threadfin shad. The  
5 effect on threadfin shad is not adverse.

6 **CEQA Conclusion:** The impact of water operations on entrainment of threadfin shad would be the  
7 same as described immediately above. The changes in entrainment under Alternative 2A would not  
8 substantially reduce and may benefit the threadfin shad population. The impact would be less than  
9 significant and no mitigation would be required.

#### 10 **Largemouth Bass**

11 Historically, entrainment of largemouth bass to the south delta export facilities peaks during the  
12 summer months. At the SWP/CVP south Delta facilities, entrainment losses under Alternative 2A are  
13 expected to decrease compared to baseline conditions, assuming largemouth bass entrainment is  
14 proportional to south Delta exports. Water exports from the south delta would decrease in all  
15 months under Alternative 2A compared to baseline conditions.

16 Largemouth bass are predominantly distributed in the central and south sections of the Delta in  
17 areas of dense SAV, and thus would have minimal overlap with propose north Delta intake facilities  
18 and alternate NBA intake on the Sacramento River. The proposed intakes would be screened to  
19 exclude fish larger than 15 mm. Largemouth bass lay demersal eggs in a nest guarded by the male,  
20 and newly hatched largemouth bass hold around their nests until they begin feeding. Parental male  
21 bass protect newly hatched young bass for several weeks. These behaviors further minimize the  
22 potential for larval largemouth bass to encounter and be entrained into the proposed north Delta  
23 intakes and NBA intake.

24 Agricultural diversions may be sources of entrainment for largemouth bass. Agricultural diversions  
25 are typically located nearshore, which is the habitat mainly used by juvenile and adult largemouth  
26 bass. Reduction or consolidation of these agricultural diversions under the Plan is not expected to  
27 increase entrainment of largemouth bass and would likely reduce overall entrainment attributable  
28 to these diversions.

29 **NEPA Effects:** Overall, entrainment of largemouth bass would decrease compared to baseline  
30 conditions. The effect from Alternative 2A is not adverse and would likely provide minor benefits.

31 **CEQA Conclusion:** The impact of water operation on largemouth bass would be as described  
32 immediately above. The changes in entrainment under Alternative 2A could benefit the largemouth  
33 bass population. The impact would be less than significant and no mitigation would be required.

#### 34 **Sacramento Tule Perch**

35 At the SWP/CVP south Delta facilities, entrainment losses under Alternative 2A would be expected  
36 to decrease compared to baseline conditions, because Sacramento tule perch entrainment is  
37 assumed to be proportional to south delta exports. Because water would be exported from the  
38 proposed north delta facilities under Alternative 2A, less water will be exported from the south  
39 delta, leading to presumed reductions in largemouth bass south delta entrainment. Additionally,  
40 reduced south delta entrainment is expected to reduce the amount of the elevated predation loss  
41 associated with these facilities, especially within Clifton Court Forebay.

1 The proposed SWP/CVP north delta intakes would be screened with state-of-the-art fish screens so  
2 only larval fish should be vulnerable to entrainment. Because Sacramento tule perch are viviparous,  
3 newly emerged Sacramento tule perch will already too large to be entrained at the north delta  
4 facilities.

5 Agricultural diversions may be sources of entrainment for Sacramento tule perch. Agricultural  
6 diversions are typically located nearshore, which is the habitat mainly used by juvenile and adult  
7 Sacramento tule perch. Reduction or consolidation of these agricultural diversions under the Plan  
8 would decrease entrainment of Sacramento tule perch into these agricultural intakes.

9 **NEPA Effects:** In summation, entrainment of Sacramento tule perch is expected to decrease  
10 compared to Existing Conditions. Overall, the effect on entrainment from Alternative 2A is not  
11 adverse.

12 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would  
13 be the same as described immediately above. The changes in entrainment under Alternative 2A  
14 would not substantially reduce the Sacramento tule perch population. The impact would be less  
15 than significant and no mitigation would be required.

#### 16 **Sacramento-San Joaquin Roach**

17 **NEPA Effects:** The effect of water operations on entrainment of Sacramento-San Joaquin roach  
18 under Alternative 2A would be similar to that described for Alternative 1A (see Alternative 1A,  
19 Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The  
20 effects would not be adverse.

21 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach  
22 would be the same as described immediately above and would be less than significant.

#### 23 **Hardhead**

24 **NEPA Effects:** The effect of water operations on entrainment of hardhead under Alternative 2A  
25 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That  
26 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
27 are relevant to the aquatic environment and aquatic species. For a discussion, please see Alternative  
28 1A, Impact AQUA-3. The effects would not be adverse.

29 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same  
30 as described immediately above and would be less than significant.

#### 31 **California Bay Shrimp**

32 California bay shrimp do not occur in the vicinity of the intakes so there would be no entrainment  
33 effect on them.

34 **CEQA Conclusion:** California bay shrimp do not occur in the vicinity of the intakes so there would no  
35 entrainment impact on them.

1 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Non-Covered Aquatic Species of Primary Management Concern**

3 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-  
4 covered species of primary management concern.

5 ***Striped Bass***

6 In general, Alternative 2A would slightly improve the quality and quantity of upstream habitat  
7 conditions for striped bass relative to NAA.

8 ***Flows***

9 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
10 Clear Creek were examined during the April through June striped bass spawning, embryo  
11 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
12 habitat available for spawning, egg incubation, and rearing.

13 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
14 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
15 *utilized in the Fish Analysis*).

16 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
17 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
18 *utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
20 than flows under NAA during April through June except in critical years during June (8% lower)  
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be substantially  
23 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
24 *utilized in the Fish Analysis*).

25 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be greater than flows  
26 under NAA regardless of water year type.

27 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
28 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
29 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

30 ***Water Temperature***

31 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
32 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
33 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
34 range could lead to reduced spawning success and increased egg and larval stress and mortality.  
35 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

36 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
37 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
38 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature  
39 related effects in these rivers during the April through June period.

1 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
2 the range would be similar to or lower than the percentage under NAA in all water year types (Table  
3 11-2A-94).

4 **Table 11-2A-94. Difference and Percent Difference in the Percentage of Months during April–June**  
5 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**  
6 **59°F to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial**  
7 **Rearing<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-3 (-6%)	-8 (-19%)
Above Normal	-27 (-60%)	-24 (-133%)
Below Normal	-12 (-28%)	-14 (-46%)
Dry	-4 (-8%)	0 (0%)
Critical	8 (21%)	-6 (-12%)
All	-6 (-14%)	-9 (-24%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

8

9 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
10 Alternative 2A would not cause a substantial reduction in striped bass spawning, incubation, or  
11 initial rearing habitat. Flows in all rivers examined during the April through June spawning,  
12 incubation, and initial rearing period under Alternative 2A would generally be similar to or greater  
13 than flows under NAA. The percentage of months outside the 59°F to 68°F water temperature range  
14 would generally be lower under Alternative 2A than under NAA.

15 **CEQA Conclusion:** In general, Alternative 2A would slightly improve the quality and quantity of  
16 upstream habitat conditions for striped bass relative to the Existing Conditions.

17 *Flows*

18 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
19 Clear Creek were examined during the April through June striped bass spawning, embryo  
20 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
21 habitat available for spawning, egg incubation, and rearing.

22 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
23 or greater than flows under Existing Conditions during April through June, except in wet years  
24 during May (15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
26 or greater than flows under Existing Conditions during April through June, except in critical years  
27 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would always be similar to or greater  
29 than flows under Existing Conditions during April through June regardless of water year type  
30 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be similar to or  
2 greater than flows under Existing Conditions during April through June, except in wet years during  
3 May (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
5 greater than flows under Existing Conditions during April and June, except in above normal years  
6 during April (7% lower) and wet and critical years during June (25% and 31% lower, respectively),  
7 but generally lower, by up to 24%, during May (Appendix 11C, *CALSIM II Model Results utilized in the*  
8 *Fish Analysis*).

9 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
10 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
11 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
12 period relative to Existing Conditions.

### 13 *Water Temperature*

14 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
15 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
16 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
17 range could lead to reduced spawning success and increased egg and larval stress and mortality.  
18 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

19 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
20 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
21 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature  
22 related effects in these rivers during the April through June period.

23 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
24 of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation,  
25 and initial rearing during April through June would be lower than the percentage under Existing  
26 Conditions in all water years except critical years (21% higher) (Table 11-2A-94).

27 Collectively, these results indicate that the impact would not be significant because Alternative 2A  
28 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of  
29 striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and  
30 Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under  
31 Alternative 2A would generally be similar to or greater than flows under the Existing Conditions.  
32 Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 2A, although this  
33 effect would not be biologically meaningful to striped bass. The percentage of months outside the  
34 59°F to 68°F water temperature range would generally be lower under Alternative 2A than under  
35 Existing Conditions.

### 36 *American Shad*

37 In general, Alternative 2A would slightly improve the quality and quantity of upstream habitat  
38 conditions for American shad relative to NAA.

### 39 *Flows*

40 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
41 Clear Creek were examined during the April through June American shad adult migration and

1 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
2 quality for spawning.

3 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
4 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
5 *utilized in the Fish Analysis*).

6 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
7 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
8 *utilized in the Fish Analysis*).

9 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
10 than flows under NAA during April through June except in critical years during June (8% lower)  
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be substantially  
13 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
14 *utilized in the Fish Analysis*).

15 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be greater than flows  
16 under NAA regardless of water year type.

17 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
18 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
19 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 20 *Water Temperature*

21 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
22 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
23 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
24 reduced spawning success and increased adult migrant stress and mortality. Water temperatures  
25 were not modeled in the San Joaquin River or Clear Creek.

26 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
27 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
28 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature  
29 related effects in these rivers during the April through June period.

30 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
31 the 60°F to 70°F water temperature range would generally be lower than the percentage under NAA  
32 depending on water year type (Table 11-2A-95).

1 **Table 11-2A-95. Difference and Percent Difference in the Percentage of Months during April–June**  
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**  
 3 **60°F to 70°F Water Temperature Range for American Shad Adult Migration and Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-6 (-14%)	-1 (-3%)
Above Normal	-6 (-17%)	-15 (-50%)
Below Normal	0 (0%)	-7 (-23%)
Dry	-2 (-5%)	-7 (-20%)
Critical	3 (8%)	-3 (-7%)
All	-3 (-7%)	-6 (-16%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 6 Alternative 2A would not cause a substantial reduction in American shad spawning or adult  
 7 migration. Flows in all rivers examined during the April through June adult migration and spawning  
 8 period under Alternative 2A would generally be similar to or greater than flows under NAA. The  
 9 percentage of months outside the 60°F to 70°F water temperature range would generally be lower  
 10 under Alternative 2A than under NAA.

11 **CEQA Conclusion:** In general, Alternative 2A would slightly improve the quality and quantity of  
 12 upstream habitat conditions for American shad relative to the Existing Conditions.

13 **Flows**

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 15 Clear Creek were examined during the April through June American shad adult migration and  
 16 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
 17 quality for spawning.

18 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
 19 or greater than flows under Existing Conditions during April through June, except in wet years  
 20 during May (15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
 22 or greater than flows under Existing Conditions during April through June, except in critical years  
 23 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would always be similar to or greater  
 25 than flows under Existing Conditions during April through June regardless of water year type  
 26 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be similar to or  
 28 greater than flows under Existing Conditions during April through June, except in wet years during  
 29 May (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
 31 greater than flows under Existing Conditions during April and June, except in above normal years  
 32 during April (7% lower) and wet and critical years during June (25% and 31% lower, respectively),

1 but generally lower, by up to 24%, during May (Appendix 11C, *CALSIM II Model Results utilized in the*  
2 *Fish Analysis*).

3 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
4 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
5 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
6 period relative to Existing Conditions.

#### 7 *Water Temperature*

8 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
9 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
10 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
11 reduced spawning success and increased adult migrant stress and mortality. Water temperatures  
12 were not modeled in the San Joaquin River or Clear Creek.

13 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
14 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
15 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature  
16 related effects in these rivers during the April through June period.

17 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
18 of the 60°F to 70°F water temperature range would be similar to or lower than the percentage under  
19 Existing Conditions in all water years except critical years (8% higher) (Table 11-2A-95).

20 Collectively, these results indicate that the impact would not be significant because Alternative 2A  
21 would not cause a substantial reduction in American shad adult migration and spawning habitat,  
22 and no mitigation is necessary. Flows in all rivers examined except the San Joaquin and Stanislaus  
23 rivers during the April through June adult migration and spawning period under Alternative 2A  
24 would generally be similar to or greater than flows under the Existing Conditions. Flows in the San  
25 Joaquin and Stanislaus rivers would be lower under Alternative 2A, although this effect would be  
26 biologically meaningful to American shad. The percentage of months outside the 60°F to 70°F water  
27 temperature range would generally be similar to or lower under Alternative 2A than under the  
28 Existing Conditions.

#### 29 ***Threadfin Shad***

30 In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
31 for threadfin shad relative to NAA.

#### 32 *Flows*

33 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
34 Clear Creek were examined during April through August threadfin shad spawning period. Lower  
35 flows could reduce the quantity and quality of instream habitat available for spawning.

36 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT during April through July  
37 would generally be similar to or greater than flows under NAA throughout the period with some  
38 exceptions (up to 15% lower). During August, flows under A2A\_LLT would generally be lower than  
39 flows under NAA, by up to 15%, depending on water year type (Appendix 11C, *CALSIM II Model*  
40 *Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
2 or greater than flows under NAA, except in critical years during August (11% lower) (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would nearly always be similar to or  
5 greater than flows under NAA throughout the period, except in critical years during June (8% lower)  
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be lower than  
8 those under NAA during July and August (up to 44% lower) and greater during April through June  
9 (up to 166% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*),

10 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar between  
11 NAA during April.

12 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
13 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
14 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

15 *Water Temperature*

16 The percentage of months below 68°F water temperature threshold for the April through August  
17 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
18 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful  
19 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear  
20 Creek.

21 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
22 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
23 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
24 related effects in these rivers throughout the year.

25 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT below  
26 68°F would be greater than those under NAA in wet above normal, and below normal water years  
27 (10% to 21% higher depending on water year type), 11% lower than those under NAA in dry years,  
28 and not different from those under NAA in critical water years (Table 11-2A-96).

29 **Table 11-2A-96. Difference and Percent Difference in the Percentage of Months during April–**  
30 **August in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below**  
31 **the 68°F Water Temperature Threshold for Threadfin Shad Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-8 (-12%)	5 (10%)
Above Normal	-16 (-21%)	13 (21%)
Below Normal	-19 (-27%)	6 (11%)
Dry	-34 (-46%)	-4 (-11%)
Critical	-28 (-44%)	0 (0%)
All	-20 (-29%)	3 (7%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

32

1 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
2 Alternative 2A would not cause a substantial reduction in spawning habitat. Flows in all rivers  
3 examined during the April through August spawning period under Alternative 2A would generally  
4 be similar to or greater than flows under NAA, except during summer months in the Sacramento,  
5 Feather, and American rivers. Lower flows during these months in these rivers are not of sufficient  
6 magnitude or frequency to have a biologically meaningful effect on threadfin shad. The percentage  
7 of months below the spawning temperature threshold would be moderately higher under  
8 Alternative 2A relative to NAA, but this increase is not expected to have a biologically meaningful  
9 effect on the threadfin shad population because there are no temperature-related effects in any  
10 other rivers.

11 **CEQA Conclusion:** In general, Alternative 2A would not affect the quality and quantity of upstream  
12 habitat conditions for threadfin shad relative to the Existing Conditions.

### 13 *Flows*

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
15 Clear Creek were examined during April through August spawning period. Lower flows could reduce  
16 the quantity and quality of instream habitat available for spawning.

17 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT during April through July  
18 would generally be similar to or greater than flows under Existing Conditions, except in wet years  
19 during May and critical years during July (15% and 13% lower, respectively). Flows under A2A\_LLT  
20 during August would generally be lower than flows under Existing Conditions, by up to 24%  
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
23 or greater than flows under Existing Conditions throughout the period, except in critical years  
24 during May and August (6% and 33% lower, respectively) and wet years during July (14% lower)  
25 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would nearly always be similar to or  
27 greater than flows under Existing Conditions throughout the period, except in critical years during  
28 August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

29 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater (up to  
30 153% greater) than flows under Existing Conditions during April through June and lower (up to  
31 50% lower) during July and August (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
32 Analysis*).

33 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to flows  
34 under Existing Conditions during April, lower during May, July, and August (up to 49% lower), and  
35 greater during June (up to 24% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
36 Analysis*).

37 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
38 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
39 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
40 period relative to Existing Conditions.

1        **Water Temperature**

2        The percentage of months below 68°F water temperature threshold for the April through August  
3        adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
4        and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful  
5        spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear  
6        Creek.

7        Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
8        2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
9        for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
10       related effects in these rivers during the April through November period.

11       In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water  
12       temperature threshold for threadfin shad spawning under A2A\_LLT would be 12% to 46% lower  
13       than the percentage under Existing Conditions, depending on water year type (Table 11-2A-96).

14       Collectively, these results indicate that the impact would not be significant because Alternative 2A  
15       would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers  
16       examined during the April through August spawning period under Alternative 2A would generally  
17       be similar to or greater than flows under the Existing Conditions, except during summer months in  
18       the Sacramento, Feather, and American rivers. Lower flows during these months in these rivers  
19       would not be of sufficient magnitude or frequency to cause a biologically meaningful effect on  
20       threadfin shad. The percentage of months outside all temperature thresholds are generally lower  
21       under Alternative 2A than under the Existing Conditions, indicating that there would be a net  
22       temperature-related benefit of Alternative 2A to threadfin shad.

23       **Largemouth Bass**

24       In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
25       for largemouth bass relative to NAA.

26       **Flows**

27       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
28       Clear Creek were examined during the March through June largemouth bass spawning period.  
29       Lower flows could reduce the quantity and quality of instream spawning habitat.

30       In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
31       or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
32       *utilized in the Fish Analysis*).

33       In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
34       or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
35       *utilized in the Fish Analysis*).

36       In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
37       than flows under NAA during March through June, except in below normal years in March (6%  
38       lower) and critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in*  
39       *the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would be substantially greater  
2 (up to 166% greater) than flows under NAA during March through June, except in below normal  
3 years during March (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
5 greater than flows under NAA during March, April, and June, with some exceptions (up to 24%  
6 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May under  
7 A2A\_LLT would generally be greater by up to 24%.

8 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
9 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
10 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

11 *Water Temperature*

12 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
13 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
14 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
15 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear  
16 Creek.

17 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
18 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
19 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
20 related effects in these rivers during the March through June period.

21 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
22 the 59°F to 75°F water temperature range would be similar to or lower than the percentage under  
23 NAA in all water years except dry years (5% higher) (Table 11-2A-97).

24 **Table 11-2A-97. Difference and Percent Difference in the Percentage of Months during March–**  
25 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside**  
26 **the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-16 (-32%)	-2 (-7%)
Below Normal	-11 (-24%)	0 (0%)
Dry	-17 (-35%)	1 (5%)
Critical	-19 (-43%)	-8 (-33%)
All	-13 (-27%)	-1 (-3%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

27  
28 **CEQA Conclusion:** In general, Alternative 2A would reduce the quality and quantity of upstream  
29 habitat conditions for largemouth bass relative to the Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3 Clear Creek were examined during the March through June largemouth bass spawning period.  
4 Lower flows could reduce the quantity and quality of instream spawning habitat.

5 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
6 or greater than flows under Existing Conditions during March through June, except in below normal  
7 years during March (10% lower) and wet years during May (15% lower) (Appendix 11C, *CALSIM II*  
8 *Model Results utilized in the Fish Analysis*).

9 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
10 or greater than flows under Existing Conditions during March through June, except in below normal  
11 years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*).

13 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would always be similar to or greater  
14 than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model*  
15 *Results utilized in the Fish Analysis*).

16 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be substantially  
17 greater (up to 153% greater) than flows under Existing Conditions during March through June,  
18 except in below normal and dry years during March (46% and 5%, respectively) and in wet years  
19 during May (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
21 greater than flows under Existing Conditions during March, April, and June, except in critical years  
22 during March and June (8% and 31% lower, respectively), above normal years during April (7%  
23 lower) and wet years during June (25% lower). Flows under A2A\_LLT in May would generally be  
24 lower, up to 24%, than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results*  
25 *utilized in the Fish Analysis*).

26 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
27 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
28 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
29 period relative to Existing Conditions.

30 *Water Temperature*

31 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
32 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
33 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
34 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear  
35 Creek.

36 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
37 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
38 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
39 related effects in these rivers during the March through June period.

1 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
2 of the 59°F to 75°F water temperature range for largemouth bass spawning would be lower than the  
3 percentage under Existing Conditions in all water years (Table 11-2A-97).

4 Collectively, these results indicate that the impact would be less than significant because Alternative  
5 2A would not cause a substantial reduction in largemouth bass habitat. No mitigation is necessary.

#### 6 ***Sacramento Tule Perch***

7 The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 2A  
8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a  
9 detailed discussion, please see Alternative 1A, Impact AQUA-202.

#### 10 ***Sacramento-San Joaquin Roach***

11 In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
12 for Sacramento-San Joaquin Roach relative to NAA.

#### 13 ***Flows***

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
15 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
16 period. Lower flows could reduce the quantity and quality of instream habitat available for  
17 spawning.

18 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
19 or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
20 *utilized in the Fish Analysis*).

21 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
22 or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
23 *utilized in the Fish Analysis*).

24 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
25 than flows under NAA during March through June, except in below normal years in March (6%  
26 lower) and critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in*  
27 *the Fish Analysis*).

28 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would be substantially greater  
29 (up to 166% greater) than flows under NAA during March through June, except in below normal  
30 years during March (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
32 greater than flows under NAA during March, April, and June, with some exceptions (up to 24%  
33 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May under  
34 A2A\_LLT would generally greater by up to 24% relative to NAA.

35 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
36 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
37 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

1 *Water Temperature*

2 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
3 Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
4 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
5 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
6 River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
8 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
9 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
10 related effects in these rivers during the March through June period.

11 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures  
12 would be below the 60.8°F water temperature threshold for roach spawning initiation under  
13 A2A\_LLT would be similar to or lower than the percentage under NAA in all water year types except  
14 below normal years (7% higher) (Table 11-2A-98).

15 **Table 11-2A-98. Difference and Percent Difference in the Percentage of Months during March–**  
16 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the**  
17 **60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach**  
18 **Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-2 (-4%)	4 (7%)
Dry	-11 (-21%)	0 (0%)
Critical	-19 (-33%)	-4 (-11%)
All	-10 (-18%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

19  
20 **CEQA Conclusion:** In general, Alternative 2A would not affect the quality and quantity of upstream  
21 habitat conditions for Sacramento-San Joaquin Roach relative to the Existing Conditions.

22 *Flows*

23 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
24 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
25 period. Lower flows could reduce the quantity and quality of instream habitat available for  
26 spawning.

27 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
28 or greater than flows under Existing Conditions during March through June, except in below normal  
29 years during March (10% lower) and wet years during May (15% lower) (Appendix 11C, *CALSIM II*  
30 *Model Results utilized in the Fish Analysis*).

31 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
32 or greater than flows under Existing Conditions during March through June, except in below normal

1 years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*  
2 *Model Results utilized in the Fish Analysis*).

3 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would always be similar to or greater  
4 than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model*  
5 *Results utilized in the Fish Analysis*).

6 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be substantially  
7 greater (up to 153% greater) than flows under Existing Conditions during March through June,  
8 except in below normal and dry years during March (46% and 5%, respectively) and in wet years  
9 during May (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
11 greater than flows under Existing Conditions during March, April, and June, except in critical years  
12 during March and June (8% and 31% lower, respectively), above normal years during April (7%  
13 lower) and wet years during June (25% lower). Flows under A2A\_LLT in May would generally be  
14 lower, up to 24%, than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results*  
15 *utilized in the Fish Analysis*).

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
17 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
18 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
19 period relative to Existing Conditions.

#### 20 *Water Temperature*

21 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
22 Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
23 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
24 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
25 River or Clear Creek.

26 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
27 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
28 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
29 related effects in these rivers during the March through June period.

30 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures  
31 would be below the 60.8°F water temperature threshold for roach spawning initiation under  
32 A2A\_LLT would be lower than the percentage under Existing Conditions in all water years (Table  
33 11-2A-98).

#### 34 **Hardhead**

35 In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
36 for hardhead relative to NAA.

#### 37 *Flows*

38 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
39 Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
40 could reduce the quantity and quality of instream habitat available for spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
2 or greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*  
3 *utilized in the Fish Analysis*).

4 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
5 or greater than flows under throughout the period (Appendix 11C, *CALSIM II Model Results utilized*  
6 *in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would always to be similar to flows  
8 under NAA throughout the period regardless of water year type (Appendix 11C, *CALSIM II Model*  
9 *Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be substantially  
11 greater (up to 166% greater) than flows under NAA throughout the period (Appendix 11C, *CALSIM*  
12 *II Model Results utilized in the Fish Analysis*).

13 In the American River at Nimbus Dam, flows under A2A\_LLT would be similar to flows under NAA in  
14 April. During May, flows under A2A\_LLT would generally be greater than flows under NAA (up to  
15 24% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
17 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
18 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 19 *Water Temperature*

20 The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
21 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
22 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
23 spawning success and increased egg and larval stress and mortality. Water temperatures were not  
24 modeled in the San Joaquin River or Clear Creek.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
26 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
27 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
28 related effects in these rivers throughout the year.

29 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
30 the range would generally be lower than the percentage under NAA in all water year types except  
31 below normal, in which there would be no difference (Table 11-2A-99).

1 **Table 11-2A-99. Difference and Percent Difference in the Percentage of Months during April–May**  
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**  
 3 **59°F to 64°F Water Temperature Range for Hardhead Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-4 (-6%)	-6 (-10%)
Above Normal	-18 (-29%)	-9 (-20%)
Below Normal	21 (50%)	0 (0%)
Dry	-8 (-15%)	-3 (-6%)
Critical	-4 (-8%)	-4 (-8%)
All	-2 (-4%)	-4 (-8%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 2A would not affect the quality and quantity of upstream  
 6 habitat conditions for hardhead relative to the Existing Conditions.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 9 Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
 10 could reduce the quantity and quality of instream habitat available for spawning.

11 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
 12 or greater than flows under Existing Conditions throughout the period, except in wet years during  
 13 May (15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
 15 or greater than flows under Existing Conditions throughout the period, except in critical years  
 16 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would always be similar to or greater  
 18 than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*  
 19 *utilized in the Fish Analysis*).

20 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be similar to or  
 21 greater than flows under Existing Conditions throughout the period, except in wet years during May  
 22 (30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 In the American River at Nimbus Dam, flows under A2A\_LLT would be similar to or greater than  
 24 flows under Existing Conditions during April except in above normal years (7% lower) and  
 25 generally lower than flows under Existing Conditions, by up to 24%, during May (Appendix 11C,  
 26 *CALSIM II Model Results utilized in the Fish Analysis*).

27 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
 28 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
 29 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
 30 period relative to Existing Conditions.

1 *Water Temperature*

2 The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
3 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
4 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
5 spawning success and increased egg and larval stress and mortality. Water temperatures were not  
6 modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
8 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
9 for Alternative 1A.

10 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
11 of the 59°F to 64°F water temperature range for hardhead spawning would be lower than the  
12 percentage under Existing Conditions in all water years except below normal years (50% higher)  
13 (Table 11-2A-99).

14 ***California Bay Shrimp***

15 The effect of water operations on spawning habitat of California bay shrimp under Alternative 2A  
16 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-4). That  
17 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
18 are relevant to the aquatic environment and aquatic species.

19 ***NEPA Effects:*** For a discussion, please see Alternative 1A, Impact AQUA-4. That discussion under  
20 delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the  
21 aquatic environment and aquatic species. The effects would not be adverse.

22 ***CEQA Conclusion:*** The impact of water operations on spawning habitat of California bay shrimp  
23 would be the same as described immediately above. The impacts would be less than significant.

24 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic  
25 Species of Primary Management Concern**

26 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-  
27 covered species of primary management concern.

28 ***Striped Bass***

29 ***NEPA Effects:*** The discussion under Alternative 2A, Impact AQUA-202 for striped bass also  
30 addresses the egg incubation and initial rearing period. That analysis indicates that there is no  
31 adverse effect on striped bass rearing during that period. Other effects of water operations on  
32 rearing habitat for striped bass under Alternative 2A would be similar to that described for  
33 Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see  
34 Alternative 2A, Impact AQUA-202. The effects would not be adverse.

35 ***CEQA Conclusion:*** As described above the impacts on striped bass rearing habitat would be less  
36 than significant.

37 ***American Shad***

38 ***NEPA Effects:*** The effects of water operations on rearing habitat for American shad under  
39 Alternative 2A would be similar to that described for Alternative 1A (see Alternative 1A, Impact

1 AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects  
2 would not be adverse.

3 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less  
4 than significant.

#### 5 **Threadfin Shad**

6 **NEPA Effects:** The effects of water operations on rearing habitat for threadfin shad under  
7 Alternative 2A would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
8 AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects  
9 would not be adverse.

10 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less  
11 than significant.

#### 12 **Largemouth Bass**

##### 13 *Juveniles*

##### 14 *Flows*

15 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
16 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
17 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
18 rearing.

19 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
20 or greater than flows under NAA during all months but August and November with some exceptions  
21 (up to 15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
22 A2A\_LLT during August and November would be lower, by up to 25%, than NAA depending on  
23 month, water year type, and time period.

24 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
25 or greater than flows under NAA during the April through November period with some exceptions  
26 (up to 58% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
28 than NAA throughout the year, except in critical years during June (8% lower) (Appendix 11C,  
29 *CALSIM II Model Results utilized in the Fish Analysis*).

30 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be lower (up to  
31 52%) than flows under NAA during July through September, greater during April through June and  
32 October (up to 105% greater), and similar during November (Appendix 11C, *CALSIM II Model Results*  
33 *utilized in the Fish Analysis*).

34 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to NAA  
35 during April, October and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
36 *Analysis*).

37 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
38 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
39 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

1 *Water Temperature*

2 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
3 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
4 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
5 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
6 temperatures were not modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
8 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
9 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
10 related effects in these rivers during the April through November period.

11 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under  
12 NAA or A2A\_LLT (Table 11-2A-100). As a result, there would be no difference in the percentage of  
13 months in which the 88°F water temperature threshold is exceeded between Alternative 2A and  
14 NAA.

15 **Table 11-2A-100. Difference and Percent Difference in the Percentage of Months during April–**  
16 **November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed**  
17 **the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

18  
19 *Adults*

20 *Flows*

21 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
22 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows  
23 could reduce the quantity and quality of instream habitat available for adult rearing.

24 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
25 or greater than flows under NAA during all months but August and November with some exceptions  
26 (up to 15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
27 A2A\_LLT during August and November would be lower than flows under NAA (up to 25% and 17%  
28 lower depending on month, water year type, and time period).

29 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
30 or greater than flows under NAA with some exceptions (up to 12% lower) (Appendix 11C, *CALSIM II*  
31 *Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
2 than NAA throughout the year, except in critical years during February and June (6% and 8% lower,  
3 respectively) and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model*  
4 *Results utilized in the Fish Analysis*).

5 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater than  
6 those under NAA during February through June and October (up to 105% greater), similar during  
7 January, November, and December, and lower during July through September (up to 52% lower)  
8 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be greater than flows  
10 under NAA during May and June (up to 24% greater), lower during July through September (up to  
11 27% lower), and similar during the remaining months (Appendix 11C, *CALSIM II Model Results*  
12 *utilized in the Fish Analysis*).

13 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
14 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
15 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

16 *Water Temperature*

17 The percentage of months above the 86°F water temperature threshold for year-round adult  
18 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
19 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
20 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
21 modeled in the San Joaquin River or Clear Creek.

22 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
23 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
24 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
25 related effects in these rivers during the year-round period.

26 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under  
27 NAA or A2A\_LLT (Table 11-2A-101). As a result, there would be no difference in the percentage of  
28 years in which the 86°F water temperature threshold is exceeded between Alternative 2A and NAA.

29 **Table 11-2A-101. Difference and Percent Difference in the Percentage of Months Year-Round in**  
30 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**  
31 **Water Temperature Threshold for Adult Largemouth Bass Survival<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in months outside suitable range) of the alternative.

32

1 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
2 Alternative 2A would not cause a substantial reduction in juvenile and adult rearing habitat. Flows  
3 in all rivers examined during the year under Alternative 2A are generally similar to or greater than  
4 flows under NAA in most months. Flows in July through September are generally lower in the  
5 Feather River high flow channel and in the American River below Nimbus Dam, although these  
6 reductions would not be biologically meaningful to the largemouth bass population. The percentage  
7 of months outside all temperature thresholds examined in the Feather River under Alternative 2A  
8 are generally similar to or lower than under NAA. There would be no temperature-related effects in  
9 any other rivers examined.

10 **CEQA Conclusion:** In general, Alternative 2A would reduce the quality and quantity of upstream  
11 habitat conditions for largemouth bass relative to the Existing Conditions.

## 12 *Juveniles*

### 13 *Flows*

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
15 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
16 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
17 rearing.

18 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
19 or greater than flows under Existing Conditions in all months but August and November with some  
20 exceptions (up to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
21 Flows during August and November under A2A\_LLT would be up to 24% lower than flows under  
22 Existing Conditions.

23 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT during April through  
24 September would generally be similar to or greater than flows under Existing Conditions throughout  
25 the year with some exceptions (up to 58% lower) (Appendix 11C, *CALSIM II Model Results utilized in*  
26 *the Fish Analysis*). Flows under A2A\_LLT during October and November would be up to 25% lower  
27 than flows under Existing Conditions.

28 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
29 than flows under Existing Conditions throughout the April through November period, except in  
30 critical years during August through November (6% to 29% lower) (Appendix 11C, *CALSIM II Model*  
31 *Results utilized in the Fish Analysis*).

32 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater (up to  
33 217% greater) than flows under Existing Conditions during April through June and September  
34 through October and lower (up to 50% lower) during July, August, and November (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be similar to or  
37 greater than flows under Existing Conditions during April and October with some exceptions (up to  
38 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
39 A2A\_LLT during May, July through September, and November would be lower by up to 50% and  
40 flows during October would be similar between Existing Conditions and A2A\_LLT.

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
2 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
3 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
4 period relative to Existing Conditions.

#### 5 *Water Temperature*

6 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
7 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
8 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
9 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
10 temperatures were not modeled in the San Joaquin River or Clear Creek.

11 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
12 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
13 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
14 related effects in these rivers during the April through November period.

15 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F  
16 water temperature threshold for April through November juvenile largemouth bass occurrence  
17 under Existing Conditions or A2A\_LLT (Table 11-2A-100). As a result, there would be no difference  
18 in the percentage of months in which the 88°F water temperature threshold is exceeded between  
19 Alternative 2A and the Existing Conditions.

#### 20 *Adults*

##### 21 *Flows*

22 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
23 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower  
24 flows could reduce the quantity and quality of instream habitat available for adult rearing.

25 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
26 or greater than flows under Existing Conditions during all months but August and November with  
27 some exceptions (up to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
28 *Analysis*). Flows under A2A\_LLT during August and November would be lower than flows under  
29 Existing Conditions (up to 24% lower and 13% lower, respectively).

30 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
31 or greater than flows under Existing Conditions throughout the year with some exceptions (up to  
32 58% lower), except during October and November when it would generally be lower (up to 25%  
33 lower during both months) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
35 than flows under Existing Conditions throughout the year, except in critical years during August  
36 through November (6% to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
37 *Analysis*).

38 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater than  
39 those under Existing Conditions during March through June and September through October (up to  
40 217% greater), lower during February, July through August, and November through December (up

1 to 50% lower), and similar during January (Appendix 11C, *CALSIM II Model Results utilized in the*  
2 *Fish Analysis*).

3 In the American River at Nimbus Dam, flows under A2A\_LLТ would generally greater than flows  
4 under Existing Conditions during February, March, and June (up to 27% greater), lower during  
5 January, May, July through September, and November through December (up to 49% lower), and  
6 similar during April and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
7 *Analysis*).

8 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
9 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
10 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
11 period relative to Existing Conditions.

### 12 *Water Temperature*

13 The percentage of months above the 86°F water temperature threshold for year-round adult  
14 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
15 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
16 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
17 modeled in the San Joaquin River or Clear Creek.

18 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
19 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
20 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
21 related effects in these rivers during the April through November period.

22 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F  
23 water temperature range for year-round adult largemouth bass occurrence under Existing  
24 Conditions or A2A\_LLТ (Table 11-2A-101). As a result, there would be no difference in the  
25 percentage of months in which the 86°F water temperature threshold is exceeded between  
26 Alternative 2A and the Existing Conditions.

27 Collectively, these results indicate that the impact would be significant because Alternative 2A  
28 would cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower  
29 during the majority of the year-round adult rearing period in the American River and in nearly half  
30 of the period (5 months) in the Feather River. Reduced flows in other rivers including the San  
31 Joaquin and Stanislaus rivers would not have biologically meaningful effects on largemouth bass.  
32 The percentages of months outside all temperature thresholds are generally lower under  
33 Alternative 2A than under the Existing Conditions. This impact is a result of the specific reservoir  
34 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing  
35 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a  
36 less-than-significant level would fundamentally change the alternative, thereby making it a different  
37 alternative than that which has been modeled and analyzed. As a result, this impact is significant and  
38 unavoidable because there is no feasible mitigation available.

39 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
40 using two unique baselines. The NEPA conclusion was based on the comparison of A2A\_LLТ with  
41 NAA and the CEQA conclusion was based on the comparison of A2A\_LLТ with Existing Conditions.  
42 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
43 water years whereas the CEQA Existing Conditions do not. Second, the NAA is assumed to occur

1 during the late long-term implementation period whereas the CEQA conclusion assumes existing  
2 climate conditions. Therefore, differences in model outputs between Existing Conditions and  
3 Alternative 2A are due primarily to both the alternative and future climate change.

#### 4 ***Sacramento Tule Perch***

5 In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
6 for Sacramento tule perch relative to NAA.

#### 7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
9 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
10 reduce the quantity and quality of instream habitat available for rearing.

11 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
12 or greater than flows under NAA during all months but August and November with some exceptions  
13 (up to 15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
14 A2A\_LLT during August and November would be lower than flows under NAA (up to 25% and 17%  
15 lower depending on month, water year type, and time period).

16 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
17 or greater than flows under NAA with some exceptions (up to 12% lower) (Appendix 11C, *CALSIM II*  
18 *Model Results utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally similar to or greater  
20 than NAA throughout the year, except in critical years during February and June (6% and 8% lower,  
21 respectively) and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model*  
22 *Results utilized in the Fish Analysis*).

23 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally greater than  
24 those under NAA during February through June and October (up to 105% greater), similar during  
25 January, November, and December, and lower during July through September (up to 52% lower)  
26 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 In the American River at Nimbus Dam, flows under A2A\_LLT would generally be greater than flows  
28 under NAA during May and June (up to 24% greater), lower during July through September (up to  
29 27% lower), and similar during the remaining months (Appendix 11C, *CALSIM II Model Results*  
30 *utilized in the Fish Analysis*).

31 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
32 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
33 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 34 *Water Temperature*

35 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-  
36 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,  
37 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds  
38 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water  
39 temperatures were not modeled in the San Joaquin River or Clear Creek.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
2 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
3 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
4 related effects in these rivers throughout the year.

5 In the Feather River below Thermalito Afterbay, the percentage of years under A2A\_LLT exceeding  
6 the 72°F threshold would be higher than the percentage under NAA by 13% to 73% depending on  
7 water year type (Table 11-2A-102). Although relative differences in above normal, below normal,  
8 and critical years are large due to small values, the absolute differenced in percent exceedance are  
9 only 2% to 4%, respectively, and do not represent biologically meaningful effects to Sacramento tule  
10 perch.

11 The percentage of months under A2A\_LLT exceeding the 75°F threshold would be similar to or  
12 lower than the percentage under NAA in all water year except wet and dry years (100% and 50%  
13 higher, respectively) (Table 11-2A-102). Although the relative differences in wet and dry years are  
14 large due to small values, the absolute differenced in percent exceedance are only 0.3% and 1%,  
15 respectively, and do not represent biologically meaningful effects to Sacramento tule perch.

16 **Table 11-2A-102. Difference and Percent Difference in the Percentage of Months Year-Round in**  
17 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F**  
18 **Water Temperature Thresholds for Sacramento Tule Perch Occurrence<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
<b>72°F Threshold</b>		
Wet	5 (214%)	5 (73%)
Above Normal	2 (NA)	2 (67%)
Below Normal	7 (NA)	4 (58%)
Dry	12 (NA)	6 (56%)
Critical	13 (300%)	2 (13%)
All	8 (562%)	4 (49%)
<b>75°F Threshold</b>		
Wet	0.3 (NA)	0.3 (100%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	2 (NA)	1 (50%)
Critical	6 (900%)	0 (0%)
All	1 (1,400%)	0.3 (20%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

19

20 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
21 Alternative 2A would not cause a substantial reduction in Sacramento tule perch rearing habitat.  
22 Flows under Alternative 2A in all rivers examined throughout the year are generally similar to or  
23 greater than flows under NAA, except during summer months in the Feather and American rivers.  
24 These reductions in flows, however, would not result in an overall biologically meaningful effect on

1 Sacramento tule perch. The percentages of months outside temperature thresholds under  
2 Alternative 2A are generally similar to the percentages under NAA.

3 **CEQA Conclusion:** In general, Alternative 2A would not affect the quality and quantity of upstream  
4 habitat conditions for Sacramento tule perch relative to the Existing Conditions.

#### 5 *Flows*

6 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
7 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
8 reduce the quantity and quality of instream habitat available for rearing.

9 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
10 or greater than flows under Existing Conditions during all months but August and November with  
11 some exceptions (up to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
12 *Analysis*). Flows under A2A\_LLT during August and November would be lower than flows under  
13 Existing Conditions (up to 24% lower and 13% lower, respectively).

14 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
15 or greater than flows under Existing Conditions throughout the year with some exceptions (up to  
16 58% lower), except during October and November when it would generally be lower (up to 25% for  
17 during both months) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
19 than flows under Existing Conditions throughout the year, except in critical years during August  
20 through November (6% to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
21 *Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater than  
23 those under Existing Conditions during March through June and September through October (up to  
24 217% greater), lower during February, July through August, and November through December (up  
25 to 50% lower), and similar during January (Appendix 11C, *CALSIM II Model Results utilized in the*  
26 *Fish Analysis*).

27 In the American River at Nimbus Dam, flows under A2A\_LLT would generally greater than flows  
28 under Existing Conditions during February, March, and June (up to 27% greater), lower during  
29 January, May, July through September, and November through December (up to 49% lower), and  
30 similar during April and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
31 *Analysis*).

32 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
33 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
34 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
35 period relative to Existing Conditions.

#### 36 *Water Temperature*

37 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round  
38 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,  
39 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead  
40 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not  
41 modeled in Clear Creek or the San Joaquin River.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
2 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
3 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
4 related effects in these rivers during the year.

5 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT  
6 exceeding 72°F relative to the percentage under Existing Conditions would be similar to or higher,  
7 by up to 300% (Table 11-2A-102).

8 The percentage of months under A2A\_LLT exceeding 75°F would be similar to the percentage under  
9 Existing Conditions in all water years except critical years (900% higher) (Table 11-2A-102).

10 Collectively, these results indicate that the impact would be significant because Alternative 2A  
11 would cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially  
12 lower during the majority of the year-round period in the American River and in half of the period in  
13 the Feather River. Flows in other rivers would not have biologically meaningful effects. The  
14 percentages of months above both temperature thresholds are generally lower under Alternative 2A  
15 than under the Existing Conditions. This impact is a result of the specific reservoir operations and  
16 resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
17 operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-  
18 significant level would fundamentally change the alternative, thereby making it a different  
19 alternative than that which has been modeled and analyzed. As a result, this impact is significant and  
20 unavoidable because there is no feasible mitigation available.

21 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
22 using two unique baselines. The NEPA conclusion was based on the comparison of A2A\_LLT with  
23 NAA and the CEQA conclusion was based on the comparison of A2A\_LLT with Existing Conditions.  
24 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
25 water years whereas the CEQA Existing Conditions do not. Second, the NAA baseline is assumed to  
26 occur during the late long-term implementation period whereas the CEQA conclusion assumes  
27 existing climate conditions. Therefore, differences in model outputs between Existing Conditions  
28 and Alternative 2A are due primarily to both the alternative and future climate change.

### 29 ***Sacramento-San Joaquin Roach***

30 In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
31 for Sacramento-San Joaquin roach relative to NAA.

#### 32 *Flows*

33 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
34 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
35 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
36 rearing.

37 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
38 or greater than flows under NAA during all months but August and November with some exceptions  
39 (up to 15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
40 A2A\_LLT during August and November would be lower than flows under NAA (up to 25% and 17%  
41 lower depending on month, water year type, and time period).

1 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
2 or greater than flows under NAA with some exceptions (up to 12% lower) (Appendix 11C, *CALSIM II*  
3 *Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
5 than NAA throughout the year, except in critical years during February and June (6% and 8% lower,  
6 respectively) and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model*  
7 *Results utilized in the Fish Analysis*).

8 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater than  
9 those under NAA during February through June and October (up to 105% greater), similar during  
10 January, November, and December, and lower during July through September (up to 52% lower)  
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 In the American River at Nimbus Dam, flows under A2A\_LLT would be greater than flows under NAA  
13 during May and June (up to 24% greater), lower during July through September (up to 27% lower),  
14 and similar during the remaining months (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
15 *Analysis*).

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
17 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
18 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 19 *Water Temperature*

20 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
21 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
22 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing  
23 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San  
24 Joaquin River or Clear Creek.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
26 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
27 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
28 related effects in these rivers throughout the year.

29 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under  
30 NAA or A2A\_LLT (Table 11-2A-103). As a result, there would be no difference in the percentage of  
31 months in which the 86°F water temperature threshold is exceeded between Alternative 2A and  
32 NAA.

1 **Table 11-2A-103. Difference and Percent Difference in the Percentage of Months Year-Round in**  
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**  
 3 **Water Temperature Range for Sacramento-San Joaquin Roach Survival<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 6 Alternative 2A would not cause a substantial reduction in spawning and juvenile and adult  
 7 Sacramento-San Joaquin roach rearing habitat. Flows under Alternative 2A in all rivers examined  
 8 throughout the year are generally similar to or greater than flows under NAA, except during  
 9 summer months in the Feather and American rivers, although these reductions would not be  
 10 biologically meaningful to the roach population. The percentage of months outside temperature  
 11 thresholds are generally similar to or lower under Alternative 2A than under NAA.

12 **CEQA Conclusion:** In general, Alternative 2A would not affect the quality and quantity of upstream  
 13 habitat conditions for Sacramento-San Joaquin Roach relative to the Existing Conditions.

14 **Flows**

15 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 16 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
 17 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
 18 rearing.

19 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
 20 or greater than flows under Existing Conditions during all months but August and November with  
 21 some exceptions (up to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
 22 *Analysis*). Flows under A2A\_LLT during August and November would be lower than flows under  
 23 Existing Conditions (up to 24% lower and 13% lower, respectively).

24 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
 25 or greater than flows under Existing Conditions throughout the year with some exceptions (up to  
 26 58% lower), except during October and November when it would generally be lower (up to 25%  
 27 lower during both months) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
 29 than flows under Existing Conditions throughout the year, except in critical years during August  
 30 through November (6% to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
 31 *Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater than  
2 those under Existing Conditions during March through June and September through October (up to  
3 217% greater), lower during February, July through August, and November through December (up  
4 to 50% lower), and similar during January (Appendix 11C, *CALSIM II Model Results utilized in the*  
5 *Fish Analysis*).

6 In the American River at Nimbus Dam, flows under A2A\_LLT would generally greater than flows  
7 under Existing Conditions during February, March, and June (up to 27% greater), lower during  
8 January, May, July through September, and November through December (up to 49% lower), and  
9 similar during April and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
10 *Analysis*).

11 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
12 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
13 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
14 period relative to Existing Conditions.

#### 15 *Water Temperature*

16 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
17 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
18 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced  
19 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.  
20 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

21 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
22 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
23 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
24 related effects in these rivers during the April through November period.

25 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water  
26 temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or  
27 A2A\_LLT (Table 11-2A-103). As a result, there would be no difference in the percentage of months in  
28 which the 86°F water temperature threshold is exceeded between Alternative 2A and the Existing  
29 Conditions.

30 Collectively, these results indicate that the impact would be significant because Alternative 2A  
31 would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be  
32 substantially lower during the majority of the year-round juvenile and adult rearing period in the  
33 American River and in half of the period in the Feather River. Flows in other rivers would not have  
34 biologically meaningful effects. The percentages of months outside both temperature thresholds are  
35 generally lower under Alternative 2A than under the Existing Conditions. This impact is a result of  
36 the specific reservoir operations and resulting flows associated with this alternative. Applying  
37 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
38 reduce this impact to a less-than-significant level would fundamentally change the alternative,  
39 thereby making it a different alternative than that which has been modeled and analyzed. As a  
40 result, this impact is significant and unavoidable because there is no feasible mitigation available.

41 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
42 using two unique baselines. The NEPA conclusion was based on the comparison of A2A\_LLT with  
43 NAA and the CEQA conclusion was based on the comparison of A2A\_LLT with Existing Conditions.

1 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
2 water years whereas the CEQA Existing Conditions do not. Second, the NAA is assumed to occur  
3 during the late long-term implementation period whereas the CEQA conclusion assumes existing  
4 climate conditions. Therefore, differences in model outputs between the Existing Conditions and  
5 Alternative 2A are due primarily to both the alternative and future climate change.

### 6 **Hardhead**

7 In general, Alternative 2A would not affect the quality and quantity of upstream habitat conditions  
8 for hardhead relative to NAA.

### 9 **Flows**

10 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
11 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
12 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
13 adult rearing.

14 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLTP would generally be similar to  
15 or greater than flows under NAA during all months but August and November with some exceptions  
16 (up to 15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
17 A2A\_LLTP during August and November would be lower than flows under NAA (up to 25% and 17%  
18 lower depending on month, water year type, and time period).

19 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLTP would generally be similar to  
20 or greater than flows under NAA with some exceptions (up to 12% lower) (Appendix 11C, *CALSIM II*  
21 *Model Results utilized in the Fish Analysis*).

22 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLTP would generally be similar to or greater  
23 than NAA throughout the year, except in critical years during February and June (6% and 8% lower,  
24 respectively) and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model*  
25 *Results utilized in the Fish Analysis*).

26 In the Feather River at Thermalito Afterbay, flows under A2A\_LLTP would generally be greater than  
27 those under NAA during February through June and October (up to 105% greater), similar during  
28 January, November, and December, and lower during July through September (up to 52% lower)  
29 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 In the American River at Nimbus Dam, flows under A2A\_LLTP would generally be greater than flows  
31 under NAA during May and June (up to 24% greater), lower during July through September (up to  
32 27% lower), and similar during the remaining months (Appendix 11C, *CALSIM II Model Results*  
33 *utilized in the Fish Analysis*).

34 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
35 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
36 for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

### 37 **Water Temperature**

38 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for  
39 juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,  
40 and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat

1 quality and increased stress and mortality. Water temperatures were not modeled in the San  
2 Joaquin River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
4 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
5 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
6 related effects in these rivers throughout the year.

7 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
8 the range would be similar to or lower than the percentage under NAA in all water year except  
9 below normal (9% higher) (Table 11-2A-104).

10 **Table 11-2A-104. Difference and Percent Difference in the Percentage of Months Year-Round in**  
11 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F**  
12 **to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A2A_LLT	NAA vs. A2A_LLT
Wet	-1 (-1%)	2 (3%)
Above Normal	-8 (-11%)	-4 (-6%)
Below Normal	-5 (-7%)	6 (9%)
Dry	-8 (-11%)	0 (-1%)
Critical	-6 (-8%)	1 (2%)
All	-5 (-7%)	1 (2%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

13  
14 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
15 Alternative 2A would not cause a substantial reduction in spawning and juvenile and adult hardhead  
16 rearing. Flows under Alternative 2A in all rivers examined throughout the year are generally similar  
17 to or greater than flows under NAA, except during summer months in the Feather and American  
18 rivers. These reductions in flows, however, would not cause an overall biologically meaningful effect  
19 on hardhead. The percentages of months outside all temperature thresholds are generally lower  
20 under Alternative 2A than under NAA.

21 **CEQA Conclusion:** In general, Alternative 2A would not affect the quality and quantity of upstream  
22 habitat conditions for hardhead relative to the Existing Conditions.

23 *Flows*

24 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
25 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
26 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
27 adult rearing.

28 In the Sacramento River upstream of Red Bluff, flows under A2A\_LLT would generally be similar to  
29 or greater than flows under Existing Conditions during all months but August and November with  
30 some exceptions (up to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
31 *Analysis*). Flows under A2A\_LLT during August and November would be lower than flows under  
32 Existing Conditions (up to 24% lower and 13% lower, respectively).

1 In the Trinity River below Lewiston Reservoir, flows under A2A\_LLT would generally be similar to  
2 or greater than flows under Existing Conditions throughout the year with some exceptions (up to  
3 58% lower), except during October and November when it would generally be lower (up to 25%  
4 lower during both months) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In Clear Creek at Whiskeytown Dam, flows under A2A\_LLT would generally be similar to or greater  
6 than flows under Existing Conditions throughout the year, except in critical years during August  
7 through November (6% to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
8 Analysis*).

9 In the Feather River at Thermalito Afterbay, flows under A2A\_LLT would generally be greater than  
10 those under Existing Conditions during March through June and September through October (up to  
11 217% greater), lower during February, July through August, and November through December (up  
12 to 50% lower), and similar during January (Appendix 11C, *CALSIM II Model Results utilized in the  
13 Fish Analysis*).

14 In the American River at Nimbus Dam, flows under A2A\_LLT would generally greater than flows  
15 under Existing Conditions during February, March, and June (up to 27% greater), lower during  
16 January, May, July through September, and November through December (up to 49% lower), and  
17 similar during April and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
18 Analysis*).

19 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 2A would be the same as those  
20 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis  
21 for Alternative 1A indicates that there would be small to moderate reductions in flows during the  
22 period relative to Existing Conditions.

### 23 *Water Temperature*

24 The percentage of months in which year-round in-stream temperatures would be outside of the  
25 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was  
26 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures  
27 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.  
28 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

29 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative  
30 2A would be the same as those under Alternative 1A. For a discussion of the topic see the analysis  
31 for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-  
32 related effects in these rivers during the April through November period.

33 In the Feather River below Thermalito Afterbay, the percentage of months under A2A\_LLT outside  
34 of the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be  
35 similar to or lower than the percentage under Existing Conditions in all water years (Table 11-2A-  
36 104).

37 Collectively, these results indicate that the impact would be significant because Alternative 2A  
38 would cause a substantial reduction in hardhead habitat. Flows would be substantially lower during  
39 the majority of the year-round juvenile and adult rearing period in the American River and in half of  
40 the period in the Feather River. Flows in other rivers would not have biologically meaningful effects  
41 on hardhead. The percentages of months outside both temperature thresholds are generally lower  
42 under Alternative 2A than under the Existing Conditions. This impact is a result of the specific

1 reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g.,  
2 changing reservoir operations in order to alter the flows) to the extent necessary to reduce this  
3 impact to a less-than-significant level would fundamentally change the alternative, thereby making  
4 it a different alternative than that which has been modeled and analyzed. As a result, this impact is  
5 significant and unavoidable because there is no feasible mitigation available.

6 The NEPA and CEQA conclusions differ for this impact statement because they were determined  
7 using two unique baselines. The NEPA conclusion was based on the comparison of A2A\_LLT with  
8 NAA and the CEQA conclusion was based on the comparison of A2A\_LLT with Existing Conditions.  
9 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal  
10 water years whereas the CEQA Existing Conditions do not. Second, the NAA is assumed to occur  
11 during the late long-term implementation period whereas the CEQA conclusion assumes existing  
12 climate conditions. Therefore, differences in model outputs between the Existing Conditions and  
13 Alternative 2A are due primarily to both the alternative and future climate change.

#### 14 ***California Bay Shrimp***

15 ***NEPA Effects:*** The effect of water operations on rearing habitat of California bay shrimp under  
16 Alternative 2A would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
17 AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact  
18 mechanisms that are relevant to the aquatic environment and aquatic species. These effects would  
19 not be adverse.

20 ***CEQA Conclusion:*** As described above the impacts on California bay shrimp rearing habitat would  
21 be less than significant.

#### 22 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered** 23 **Aquatic Species of Primary Management Concern**

24 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-  
25 covered species of primary management concern.

#### 26 ***Striped Bass***

27 Adult striped bass migrate up the Delta via the Sacramento River to reach suitable spawning habitat  
28 upstream. It is assumed that this migration period occurs around the same timing as spawning, from  
29 April through June.

30 ***NEPA Effects:*** Flows in the Sacramento River below the north Delta diversion facilities would be  
31 lower than NAA during the April through June period. Monthly flows on average would be 14–23%  
32 lower than NAA. Sacramento River flows are highly variable interannually, and striped bass are still  
33 able to migrate upstream the Sacramento River during lower flow years. The effect of reduced  
34 Sacramento flows under Alternative 2A would not be adverse.

35 ***CEQA Conclusion:*** Impacts would be as described immediately above and would be less than  
36 significant because the changes in flow (22–30% lower compared to Existing Conditions) would not  
37 interfere substantially with movement of spawning striped bass through the Delta. No mitigation  
38 would be required.

1 **American Shad**

2 Adult American shad migrate up the Delta to reach suitable spawning habitat upstream around  
3 March-May. American shad migrate up the Sacramento River while some shad spawn in the San  
4 Joaquin River basin. Flows in the Sacramento River below the north Delta diversion facilities would  
5 be lower than NAA during March-May. Monthly flows on average would be 18-25% less than NAA.  
6 Flows from the San Joaquin River at Vernalis would be unchanged. Sacramento River flows are  
7 highly variable interannually, and American shad are still able to migrate upstream the Sacramento  
8 River during lower flow years.

9 **NEPA Effects:** Overall, the impact to American shad migration habitat conditions would not be  
10 adverse under Alternative 2A.

11 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
12 significant because the changes in flow (22-30% lower compared to Existing Conditions) would not  
13 interfere substantially with movement of American shad from the Delta to upstream spawning  
14 habitat. No mitigation would be required.

15 **Threadfin Shad**

16 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish  
17 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn.  
18 Therefore, there is no effect on migration habitat conditions.

19 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
20 significant because flow changes in the Delta under Alternative 2A would not alter movement  
21 patterns for threadfin shad. No mitigation would be required.

22 **Largemouth Bass**

23 **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use  
24 the Delta as migration habitat corridor. There would be no effect.

25 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 2A would not  
26 affect largemouth movements within the Delta. No mitigation would be required.

27 **Sacramento Tule Perch**

28 **NEPA Effects:** Similar with largemouth bass, Sacramento tule perch are a non-migratory species and  
29 do not use the Delta as a migration corridor as they are a resident Delta species. There would be no  
30 effect.

31 **CEQA Conclusion:** As described immediately above, flow changes would not affect Sacramento tule  
32 perch movements within the Delta. No migration would be required.

33 **Sacramento-San Joaquin Roach**

34 **NEPA Effects:** For Sacramento-San Joaquin roach the overall flows and temperature in upstream  
35 rivers during migration to their spawning grounds would be similar to those described under  
36 Alternative 2A, Impact AQUA-202 for spawning. As described there, the flows would slightly  
37 improve the upstream conditions relative to NAA. These conditions would not be adverse.

1 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
2 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

3 **Hardhead**

4 **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration  
5 to their spawning grounds would be similar to those described under Alternative 2A, Impact AQUA-  
6 202 for spawning. As described under Impact AQUA-202, the flows would slightly improve the  
7 upstream conditions relative to NAA. These conditions would not be adverse.

8 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
9 conditions for hardhead would not be significant and no mitigation is required.

10 **California Bay Shrimp**

11 **NEPA Effects:** The effect of water operations on migration conditions of California bay shrimp under  
12 Alternative 2A would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
13 AQUA-4). That discussion under delta smelt addresses the type, magnitude and range of impact  
14 mechanisms that are relevant to the aquatic environment and aquatic species. As described under  
15 Alternative 1A, Impact AQUA-4 the effect would not be adverse.

16 **CEQA Conclusion:** As described above the impacts on California bay shrimp rearing habitat would  
17 be less than significant.

18 **Restoration Measures (CM2, CM4–CM7, and CM10)**

19 The effects of restoration measures under Alternative 2A would be similar for all non-covered  
20 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by  
21 individual species.

22 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic  
23 Species of Primary Management Concern**

24 **NEPA Effects:** Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of  
25 construction of restoration measures on non-covered species of primary management concern. That  
26 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
27 are relevant to the aquatic environment and aquatic species. The potential effects of the  
28 construction of restoration measures under Alternative 2A would be similar to those described for  
29 Alternative 1A (see Alternative 1A, Impact AQUA-7). The effects would not be adverse.

30 **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration  
31 measures would be less than significant.

32 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-  
33 Covered Aquatic Species of Primary Management Concern**

34 **NEPA Effects:** Refer to Impact AQUA-8 under delta smelt a discussion of the effects of contaminants  
35 associated with restoration measures on non-covered species of primary management concern. That  
36 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
37 are relevant to the aquatic environment and aquatic species. The potential effects of the  
38 construction of contaminants associated with restoration measures under Alternative 2A would be

1 similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). The effects would  
2 not be adverse.

3 **CEQA Conclusion:** As described immediately above, the impacts of the contaminants associated with  
4 restoration measures would be less than significant.

5 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**  
6 **Primary Management Concern**

7 Refer to Impact AQUA-9 under delta smelt a general discussion of the effects of restored habitat  
8 conditions on non-covered species of primary management concern. Although there are minor  
9 differences the effects are similar. That discussion under delta smelt addresses the type, magnitude  
10 and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.  
11 The potential effects of restored habitat conditions under Alternative 2A would be similar to those  
12 described for Alternative 1A (see Alternative 1A, Impact AQUA-8). In addition, see Alternative 1A,  
13 Impact AQUA-207 for a discussion of the different effects on non-covered species of primary  
14 management concern.

15 **NEPA Effects:** Overall, the effects range from slightly beneficial to beneficial.

16 **CEQA Conclusion:** As described immediately above, the impacts of restored habitat conditions  
17 would range from slightly beneficial to beneficial.

18 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**  
19 **Primary Management Concern (CM12)**

20 **NEPA Effects:** Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of  
21 methylmercury management on non-covered species of primary management concern. That  
22 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
23 are relevant to the aquatic environment and aquatic species. The potential effects of methylmercury  
24 management under Alternative 2A would be similar to those described for Alternative 1A (see  
25 Alternative 1A, Impact AQUA-10). As described in detail under Alternative 1A, Impact AQUA-10. The  
26 effects would not be adverse.

27 **CEQA Conclusion:** As described immediately above, the impacts of methylmercury management  
28 would be less than significant.

29 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**  
30 **Aquatic Species of Primary Management Concern (CM13)**

31 Refer to Impact AQUA-11 under delta smelt a discussion of the effects of invasive aquatic vegetation  
32 management on non-covered species of primary management concern. That discussion under delta  
33 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the  
34 aquatic environment and aquatic species. The potential effects of invasive aquatic vegetation  
35 management under Alternative 2A would be similar to those described for Alternative 1A (see  
36 Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass)  
37 and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish  
38 which improves their hunting success. Sacramento tule perch also use the cover of aquatic plants in  
39 the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of  
40 invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch.  
41 However, this control will not substantially reduce the ability of the predatory species to hunt and

1 there will still be many other habitats in which the predatory species can successfully hunt and in  
2 which Sacramento tule perch will thrive.

3 **NEPA Effects:** The overall effect will not be adverse. Control of invasive aquatic vegetation would  
4 not occur within California bay shrimp habitat and there would be no effect on them.

5 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt a discussion of the effects of invasive  
6 aquatic vegetation management on non-covered species of primary management concern. There are  
7 minor differences and the effects are similar except for predatory species (striped bass and  
8 largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for  
9 predatory fish which improves their hunting success. Control of invasive aquatic vegetation would  
10 not occur within California bay shrimp habitat and there would be no effect on them. Sacramento  
11 tule perch use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun  
12 marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect the  
13 predatory species and Sacramento tule perch. However, this control will not substantially reduce the  
14 ability of the predatory species to hunt and there will still be many other habitats in which the  
15 predatory species can successfully hunt and in which Sacramento tule perch will thrive. Therefore  
16 the effect on them will not be significant and no mitigation is required.

#### 17 **Other Conservation Measures (CM12–CM19 and CM21)**

18 The effects of other conservation measures under Alternative 2A would be similar for all non-  
19 covered species; therefore, the analysis below is combined for all non-covered species instead of  
20 analyzed by individual species.

#### 21 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic 22 Species of Primary Management Concern (CM14)**

23 **NEPA Effects:** Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved  
24 oxygen management on non-covered species of primary management concern. That discussion  
25 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
26 to the aquatic environment and aquatic species. The potential effects of dissolved oxygen  
27 management under Alternative 2A would be similar to those described for Alternative 1A (see  
28 Alternative 1A, Impact AQUA-12). For a detailed discussion, please see Alternative 1A, Impact  
29 AQUA-12. California bay shrimp do not occur in this habitat and there would be no effect on them.  
30 These effects would be beneficial.

31 **CEQA Conclusion:** As described immediately above, the impacts of oxygen level management would  
32 be beneficial.

#### 33 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic 34 Species of Primary Management Concern (CM15)**

35 **NEPA Effects:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt a discussion of the effects  
36 of predatory fish (striped bass and largemouth bass) and predator management on non-predatory  
37 fish. That discussion under delta smelt addresses the type, magnitude and range of impact  
38 mechanisms that are relevant to the aquatic environment and aquatic species. The purpose of  
39 predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting  
40 success. This management will have negative effects on predatory fish. However, the numbers of  
41 predatory fish are high and the extent of the habitats in which they hunt is extensive. Therefore the

1 effects of this management will not be adverse. California bay shrimp do not occur in these habitats  
2 and there would be no effect on them.

3 **CEQA Conclusion:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt a discussion of the  
4 effects of predatory fish and predator management on non-predatory fish. The purpose of predatory  
5 fish management is to reduce the numbers of predatory fish and to reduce their hunting success.  
6 This management will have negative effects on predatory fish. However, the numbers of predatory  
7 fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of  
8 this management will not be significant. No mitigation is required. California bay shrimp do not  
9 occur in these habitats and there would be no effect on them.

10 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**  
11 **Primary Management Concern (CM16)**

12 Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of nonphysical fish  
13 barriers on non-covered species of primary management concern. That discussion under delta smelt  
14 addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic  
15 environment and aquatic species. The potential effects of nonphysical fish barriers under  
16 Alternative 2A would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
17 AQUA-14). For a detailed discussion, please see Alternative 1A, Impact AQUA-14. The effects would  
18 be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch which are  
19 unlikely to be present in their vicinity.

20 **NEPA Effects:** California bay shrimp do not occur in these habitats and there would be no effect on  
21 them. The effects would not be adverse.

22 **CEQA Conclusion:** As described immediately above, the impacts of nonphysical fish barriers would  
23 be less than significant.

24 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**  
25 **Primary Management Concern (CM17)**

26 Refer to Impact AQUA-15 under delta smelt for a discussion of the effects of illegal harvest reduction  
27 on non-covered species of primary management concern. That discussion under delta smelt  
28 addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic  
29 environment and aquatic species. The potential effects of illegal harvest reduction under Alternative  
30 2A would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-15). For  
31 a detailed discussion, please see Alternative 1A, Impact AQUA-15.

32 **NEPA Effects:** California bay shrimp do not occur in these habitats and there would be no effect on  
33 them. The effects would not be adverse.

34 **CEQA Conclusion:** As described immediately above, the impacts of illegal harvest reduction would  
35 be less than significant.

1 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**  
2 **Primary Management Concern (CM18)**

3 *NEPA Effects:* Refer to Impact AQUA-16 under delta smelt for a discussion of the effects of  
4 conservation hatcheries on non-covered species of primary management concern. The potential  
5 effects of conservation hatcheries under Alternative 2A would be similar to those described for  
6 Alternative 1A (see Alternative 1A, Impact AQUA-16). For a detailed discussion, please see  
7 Alternative 1A, Impact AQUA-16. There would be no effect,

8 *CEQA Conclusion:* As described immediately above, conservation hatcheries would have not impact.

9 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**  
10 **of Primary Management Concern (CM19)**

11 *NEPA Effects:* Refer to Impact AQUA-17 under delta smelt for a discussion of the effects of  
12 stormwater treatment on non-covered species of primary management concern. That discussion  
13 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
14 to the aquatic environment and aquatic species. The potential effects of stormwater treatment under  
15 Alternative 2A would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
16 AQUA-17). The effects would be beneficial.

17 *CEQA Conclusion:* As described immediately above, the impacts of stormwater management would  
18 be beneficial.

19 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
20 **Aquatic Species of Primary Management Concern (CM21)**

21 Refer to Impact AQUA-18 under delta smelt for a discussion of the effects of removal/relocation of  
22 nonproject diversions on non-covered species of primary management concern. The potential  
23 effects of removal/relocation of nonproject diversions under Alternative 2A would be similar to  
24 those described for Alternative 1A (see Alternative 1A, Impact AQUA-18). That discussion under  
25 delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the  
26 aquatic environment and aquatic species.

27 *NEPA Effects:* The effects would be similar except for Sacramento-San Joaquin roach, hardhead and  
28 Sacramento perch which are unlikely to be present near these diversions. California bay shrimp do  
29 not occur in these habitats and there would be no effect on them. The effects would not be adverse.

30 *CEQA Conclusion:* As described immediately above, the impacts of removal/relocation of nonproject  
31 diversions would be less than significant.

32 **Upstream Reservoirs**

33 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

34 *NEPA Effects:* Similar to the description for Alternative 1A, this effect would not be adverse because  
35 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 2A would not be  
36 substantially reduced when compared to NAA.

1       **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 2A would reduce the  
2       quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be  
3       a greater than 5% increase (5 years) for the reservoirs, which could result in a significant impact.  
4       These results are primarily caused by four factors: differences in sea level rise, differences in climate  
5       change, future water demands, and implementation of the alternative. The analysis described above  
6       comparing Existing Conditions to Alternative 2A does not partition the effect of implementation of  
7       the alternative from those of sea level rise, climate change and future water demands using the  
8       model simulation results presented in this chapter. However, the increment of change attributable  
9       to the alternative is well informed by the results from the NEPA analysis, which found this effect to  
10      be not adverse. As a result, the CEQA conclusion regarding Alternative 2A, if adjusted to exclude sea  
11      level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
12      result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be  
13      less than significant and no mitigation is required.

### 11.3.4.6 Alternative 2B—Dual Conveyance with East Alignment and Five Intakes (15,000 cfs; Operational Scenario B)

Alternative 2B would include the same physical/structural water conveyance components, including a surface canal and eastern alignment, culvert and tunnel siphons, and bridges as Alternative 1B. Like Alternatives 1A and 1B, Alternative 2B would include five intake facilities on the Sacramento River. Intakes one through three would be in the same locations as Alternatives 1A and 1B, but the locations of the fourth and fifth intakes may be located 5 to 6 miles downstream of the intakes described in Alternative 1A. Also, the number of barge landings has not been determined. Overall, construction impacts associated with Alternative 2B would be the same as those described for Alternative 1B.

Currently, as an alternative to Intakes 1–5, intake locations 1, 2, 3, 6, and 7 are being considered. Selection of intake locations 6 and 7 would entail construction in the same region (north Delta) and would result in the same construction effects on fish species as discussed for Alternative 1A. This alternative would convey water from five fish-screened intakes between Clarksburg and Walnut Grove (Intakes 6 and 7, if selected, would be downstream of Sutter and Steamboat Sloughs) to a new Byron Tract Forebay adjacent to CCF. Construction effects for all fish species would be similar to those analyzed for Alternative 1A. Implementation of mitigation measures (described below) and environmental commitments (see Appendix 3B, *Environmental Commitments*) would reduce impacts as described under Alternative 1A.

Alternative 2B water conveyance operational criteria (Operational Scenario B) would be modified from those described for Alternative 1A, but the same as Alternative 2A. Like Alternatives 1A and 2A, the Alternative 2B facilities could convey up to 15,000 cfs from the north Delta. Operational Scenario B includes incorporation of Fall X2 guidelines, more restrictive south Delta OMR flows, and an operable barrier at the head of Old River (see Chapter 3, *Description of Alternatives*, Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*). Operational Scenario B also includes north Delta diversion bypass flow criteria, south Delta export/inflow ratio, flow criteria over Fremont Weir into Yolo Bypass, Delta inflow and outflow criteria, DCC gate operations, Rio Vista minimum instream flow criteria, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions.

CM2–CM22 would be implemented under this alternative, and these conservation measures would be identical to those under Alternative 1A. See Chapter 3, *Description of Alternatives*, for additional details on Alternative 2B.

## Delta Smelt

### Construction and Maintenance of CM1

Construction of Alternative 2B infrastructure would occur in the same area as described for Alternative 2A, as well as Alternative 1A, except for Intakes 6 and 7. Small numbers of delta smelt eggs, larvae, and adults could be present in the in-water construction areas in June and July (see Table 11-4). These construction and maintenance sites also occur entirely within designated delta smelt critical habitat.

1 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

2 **NEPA Effects:** The potential effects of construction of water conveyance facilities on delta smelt or  
3 designated critical habitat would be similar to those described under Alternative 1A, Impact AQUA-  
4 1. As concluded in Alternative 1A, Impact AQUA-1, the effect would not be adverse for delta smelt.

5 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact  
6 of the construction of water conveyance facilities on delta smelt or critical habitat would not be  
7 significant except for construction noise associated with pile driving. Implementation of Mitigation  
8 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
9 significant.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

13 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
14 **and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

16 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

17 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
18 Alternative 2B would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
19 AQUA-2). As concluded under Alternative 1A, Impact AQUA-2, the impact would not be adverse for  
20 delta smelt.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-2 for delta smelt, the impact of the  
22 maintenance of water conveyance facilities on delta smelt would be less than significant and no  
23 mitigation is required.

24 **Water Operations of CM1**

25 While Operational Scenario B under Alternative 2B (and Alternative 2A) has slight differences from  
26 Operational Scenario A (see Alternative 2B introduction above), Alternative 2B has the same  
27 diversion and conveyance operations as Alternative 2A. As a result, there would be little or no  
28 differences between these alternatives in upstream of the Delta river flows or reservoir operations,  
29 Delta inflow, and hydrodynamics in the Delta. Because no substantial differences in fish effects are  
30 anticipated anywhere in the affected environment under Alternative 2B compared to those  
31 described in detail for Alternative 2A (Impact AQUA-3 through AQUA-6), the fish effects described  
32 for these other alternatives also appropriately characterize effects under Alternative 2B.

33 The following impacts are those presented under Alternative 2A that are identical for Alternative  
34 2B.

35 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

36 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
37 **Delta Smelt**

1 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

2 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

3 *NEPA Effects:* With the exception of Impact AQUA-5, the other impact mechanisms listed above,  
4 would not be adverse to delta smelt under Alternative 2B. This is the same conclusion as described  
5 in detail under Alternative 2A, and is based on the expected overall limited or slightly beneficial  
6 impacts. However, the overall effect of Impact AQUA-5 on delta smelt rearing habitat would remain  
7 adverse because there likely would still be a loss of suitable habitat even with BDCP restoration  
8 efforts (see Alternative 2A, AQUA-5 for details on expected effects).

9 *CEQA Conclusion:* The effects of three of the above listed impact mechanisms would be less than  
10 significant, or slightly beneficial to delta smelt, and no mitigation would be required. In addition, the  
11 effects of Impact AQUA-5 would also be considered less than significant, because it would not  
12 substantially reduce rearing habitat. Therefore, no mitigation would be required for any of the  
13 impact mechanisms listed above. Detailed discussions regarding these conclusions are presented in  
14 Alternative 1A.

15 **Restoration and Conservation Measures**

16 Alternative 2B has the same restoration and conservation measures as Alternative 1A. Because no  
17 substantial differences in fish effects are anticipated anywhere in the affected environment under  
18 Alternative 2B compared to those described in detail for Alternative 1A, the effects of these  
19 restoration and conservation measures described for Alternative 1A (Impact AQUA-7 through  
20 AQUA-18) also appropriately characterize effects under Alternative 2B.

21 The following impacts are those presented under Alternative 1A that are identical for Alternative  
22 2B.

23 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

24 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**  
25 **Smelt**

26 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

27 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

28 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

29 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

30 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

31 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

32 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

33 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

34 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

1 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
2 **(CM21)**

3 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms (Impact AQUA-7  
4 through AQUA-18) would be adverse to delta smelt, and most would be at least slightly beneficial.  
5 Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper,  
6 ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are  
7 uncertain.

8 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or  
9 less-than-significant effects, and no mitigation is required.

10 **Longfin Smelt**

11 The potential effects of construction and maintenance of water conveyance facilities, operations of  
12 water conveyance facilities, restoration measures and other conservation measures on longfin smelt  
13 would be similar to those described under Alternative 1A. Because no differences in fish effects are  
14 anticipated anywhere in the affected environment under Alternative 2B compared to those  
15 described in detail for Alternative 1A (Impact AQUA-19 and AQUA-20), the fish effects described for  
16 longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under  
17 Alternative 2B.

18 The following impacts on longfin smelt are those presented under Alternatives 1A and 2A that are  
19 identical or very similar for Alternative 2B.

20 **Construction and Maintenance of CM1**

21 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

22 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

23 *NEPA Effects:* While maintenance activities would not be adverse to longfin smelt, construction  
24 activities could result in adverse effects from impact pile driving activities. The implementation of  
25 the avoidance and minimization measures included in Mitigation Measures AQUA-1a and AQUA-1b,  
26 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

27 *CEQA Conclusion:* Similar to the discussion provided above for Alternatives 1A and 2A, most of  
28 these impact mechanisms listed above would be beneficial or less than significant, and no mitigation  
29 would be required. However, several mechanisms could result in significant effects. While Impact  
30 AQUA-19 could result in significant underwater noise effects from impact pile driving,  
31 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
32 impacts to less than significant.

33 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
34 **of Pile Driving and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

4           **Water Operations of CM1**

5           The potential effects of conveyance facility operations on longfin smelt would be similar to those  
6           described under Alternative 2A. Because no differences in fish effects are anticipated anywhere in  
7           the affected environment under Alternative 2B compared to those described in detail for Alternative  
8           2A (Impact AQUA-21 and AQUA-22), the fish effects described for longfin smelt under Alternative 2A  
9           also appropriately characterize effects for longfin smelt under Alternative 2B.

10          **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

11          **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**  
12          **Habitat for Longfin Smelt**

13          **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

14          **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

15          *NEPA Effects:* As presented under Alternative 2A, the effects of Alternative 2A operations would be  
16          expected to result in 5–6% lower longfin smelt abundance compared to NAA, for all years combined.  
17          Longfin smelt may benefit from habitat restoration actions (*CM2 Yolo Bypass Fisheries Enhancement*  
18          *and CM4 Tidal Natural Communities Restoration*, which are intended to provide additional food  
19          production and export to longfin smelt rearing areas in Suisun Marsh, West Delta, and Cache Slough  
20          ROAs.

21          *CEQA Conclusion:* As presented under Alternative 2A, the effects of Alternative 2B operations would  
22          be less than significant for spawning and rearing conditions. The effects on longfin smelt from  
23          reduced entrainment and predation would be beneficial. No mitigation would be required.

24          **Restoration and Conservation Measures**

25          The potential effects of restoration measures and other conservation measures on longfin smelt  
26          would be similar to those described under Alternative 1A. Because no differences in fish effects are  
27          anticipated anywhere in the affected environment under Alternative 2B compared to those  
28          described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the fish effects described  
29          for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under  
30          Alternative 2B.

31          **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

32          **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**  
33          **Smelt**

34          **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

35          **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

1 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
2 **(CM13)**

3 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

4 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

5 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

6 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

7 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

8 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

9 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
10 **(CM21)**

11 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, the impact mechanisms  
12 listed above would not be adverse to longfin smelt, and would typically be beneficial. Specifically for  
13 AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia  
14 and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

15 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, the impact  
16 mechanisms listed above would be beneficial or less than significant, and no mitigation would be  
17 required.

18 **Winter-Run Chinook Salmon**

19 The potential effects of construction and maintenance of water conveyance facilities, operations of  
20 water conveyance facilities, restoration measures and other conservation measures on winter-run  
21 Chinook salmon would be similar to those described under Alternatives 1A and 2A.

22 **Construction and Maintenance of CM1**

23 The potential effects of construction and maintenance activities on winter-run Chinook salmon  
24 would be similar to those described under Alternatives 1A and 2A, because no differences in fish  
25 effects are anticipated anywhere in the affected environment under Alternative 2B compared to  
26 those described in detail for these alternatives (Impact AQUA-37 and AQUA-38), the fish effects  
27 described for winter-run Chinook salmon under Alternative 1A also appropriately characterize  
28 effects under Alternative 2B.

29 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
30 **(Winter-Run ESU)**

31 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
32 **(Winter-Run ESU)**

33 *NEPA Effects:* These impact mechanisms would not be adverse to winter-run Chinook salmon. While  
34 construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving

1 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
2 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

3 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, Impact  
4 AQUA-37 could result in significant underwater noise effects from impact pile driving, although  
5 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
6 impacts to less than significant.

7 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
8 **of Pile Driving and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

10 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
11 **and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

13 **Water Operations of CM1**

14 The potential effects of operations of water conveyance facilities on winter-run Chinook salmon  
15 would be similar to those described for Alternative 2A. Because no differences in fish effects are  
16 anticipated anywhere in the affected environment under Alternative 2B compared to those  
17 described in detail for Alternative 2A (Impacts AQUA-39 through AQUA-42), the effects described  
18 for winter-run Chinook salmon also appropriately characterize the effects under Alternative 2B.

19 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**  
20 **Run ESU)**

21 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
22 **Chinook Salmon (Winter-Run ESU)**

23 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
24 **(Winter-Run ESU)**

25 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
26 **(Winter-Run ESU)**

27 **NEPA Effects:** As discussed for Alternative 2A, the impact mechanisms listed above could be adverse  
28 to winter-run Chinook salmon under Alternative 2B. The effects could be adverse because of the  
29 potential to substantially reduce suitable spawning and rearing habitat, the number of fish as a  
30 result of egg mortality, and reduced migration conditions. These effects are the result of specific  
31 reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g.,  
32 changing reservoir operations in order to alter the flows) to the extent necessary to reduce this  
33 effect to a level that is not adverse would fundamentally change the alternative, thereby making it a  
34 different alternative than that which has been modeled and analyzed. As a result, these would be an  
35 unavoidable adverse effects because there is no feasible mitigation available. However,  
36 implementing Mitigation Measure AQUA-40a through AQUA-40c and AQUA-41a through AQUA-41c  
37 has the potential to reduce the severity of impact though not necessarily to a not adverse level.

1 **CEQA Conclusion:** As discussed in detail under Alternative 2A, the effects under Alternative 2B  
2 would be significant because it has the potential to substantially reduce suitable spawning habitat  
3 and, therefore, in adult spawner and redd carrying capacity, as well as substantially reducing the  
4 number of fish as a result of egg mortality and reducing rearing habitat. These impacts are a result of  
5 the specific reservoir operations and resulting flows associated with this alternative. Applying  
6 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
7 reduce this impact to a less-than-significant level would fundamentally change the alternative,  
8 thereby making it a different alternative than that which has been modeled and analyzed. As a  
9 result, this impact is significant and unavoidable because there is no feasible mitigation available.  
10 Even so, proposed below is mitigation that has the potential to reduce the severity of impact though  
11 not necessarily to a less-than-significant level.

12 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional**  
13 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
14 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

15 Please refer to Mitigation Measure AQUA-40a under Impact AQUA-40 of Alternative 2A.

16 **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts**  
17 **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

18 Please refer to Mitigation Measure AQUA-40b under Impact AQUA-40 of Alternative 2A.

19 **Mitigation Measure AQUA-40c: Consult with NMFS, USFWS, and CDFW to Identify and**  
20 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
21 **Salmon Spawning Habitat Consistent with CM1**

22 Please refer to Mitigation Measure AQUA-40c under Impact AQUA-40 of Alternative 2A.

23 **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**  
24 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
25 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

26 Please refer to Mitigation Measure AQUA-41a under Impact AQUA-41 of Alternative 2A.

27 **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**  
28 **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

29 Please refer to Mitigation Measure AQUA-41b under Impact AQUA-41 of Alternative 2A.

30 **Mitigation Measure AQUA-41c: Consult with NMFS, USFWS, and CDFW to Identify and**  
31 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
32 **Salmon Rearing Habitat Consistent with CM1**

33 Please refer to Mitigation Measure AQUA-41c under Impact AQUA-41 of Alternative 2A.

34 **Restoration and Conservation Measures**

35 The potential effects of restoration measures and other conservation measures on winter-run  
36 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
37 fish effects are anticipated anywhere in the affected environment under Alternative 2B compared to

1 those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects  
2 described for winter-run Chinook salmon under Alternative 1A also appropriately characterize  
3 effects under Alternative 2B.

4 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
5 **(Winter-Run ESU)**

6 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
7 **Salmon (Winter-Run ESU)**

8 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
9 **ESU)**

10 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
11 **ESU) (CM12)**

12 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
13 **(Winter-Run ESU) (CM13)**

14 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
15 **Run ESU) (CM14)**

16 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
17 **(Winter-Run ESU) (CM15)**

18 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
19 **(CM16)**

20 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
21 **(CM17)**

22 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
23 **(CM18)**

24 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
25 **ESU) (CM19)**

26 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
27 **(Winter-Run ESU) (CM21)**

28 **NEPA Effects:** As discussed in detail for Alternative 1A, the impact mechanisms listed above would  
29 not be adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for  
30 AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium,  
31 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run  
32 Chinook salmon are uncertain.

33 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
34 mechanisms would be less than significant, or beneficial, so no additional mitigation would be  
35 required.

1       **Spring-Run Chinook Salmon**

2       The potential effects of construction and maintenance, operations of water conveyance facilities,  
3       restoration measures and other conservation measures on spring-run Chinook salmon would be  
4       similar to those described under Alternative 1A.

5       **Construction and Maintenance of CM1**

6       The potential effects of construction and maintenance activities on spring-run Chinook salmon  
7       would be similar to those described under Alternatives 1A and 2A, because no differences in fish  
8       effects are anticipated anywhere in the affected environment under Alternative 2B compared to  
9       those described in detail for Alternative 1A (Impact AQUA-55 through AQUA-56), the fish effects  
10      described for spring-run Chinook salmon under Alternative 1A also appropriately characterize  
11      effects for spring-run Chinook salmon under Alternative 2B

12      **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
13      **(Spring-Run ESU)**

14      **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
15      **(Spring-Run ESU)**

16      *NEPA Effects:* These impact mechanisms would not be adverse to spring-run Chinook salmon. While  
17      construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving  
18      activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
19      eliminate adverse effects from impact pile driving (e.g., injury or mortality).

20      *CEQA Conclusion:* Similar to the discussion provided above for Alternatives 1A and 2A, Impact  
21      AQUA-55 could result in significant underwater noise effects from impact pile driving, although  
22      implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
23      impacts to less than significant.

24      **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
25      **of Pile Driving and Other Construction-Related Underwater Noise**

26      Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

27      **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
28      **and Other Construction-Related Underwater Noise**

29      Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

30      **Water Operations of CM1**

31      The potential effects of water conveyance facility operations on spring-run Chinook salmon would  
32      be similar to those described under Alternative 2A. Because no differences in fish effects are  
33      anticipated anywhere in the affected environment under Alternative 2B compared to Alternative 2A  
34      (Impact AQUA-57 through AQUA-60), the fish effects described for spring-run Chinook salmon  
35      under Alternatives 2A also appropriately characterize effects under Alternative 2B.

1 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
2 **ESU)**

3 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
4 **Chinook Salmon (Spring-Run ESU)**

5 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**  
6 **Run ESU)**

7 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
8 **(Spring-Run ESU)**

9 **NEPA Effects:** As discussed in detail for Alternative 2A, except for Impact AQUA-60, the impact  
10 mechanisms listed above would not be adverse to spring-run Chinook salmon under Alternative 2B.  
11 However, adverse effects would occur from Impact AQUA-60 because habitat and migration  
12 conditions for juvenile spring-run Chinook salmon would be substantially reduced, and because it  
13 has the potential to substantially increase predation and remove important instream habitat as the  
14 result of the presence of five north Delta intake structures. The implementation of conservation and  
15 mitigation measures would reduce the severity of effects, although not necessarily to a not adverse  
16 level.

17 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 2A, three of the impact  
18 mechanisms listed above would be less than significant under Alternative 2B, so no additional  
19 mitigation would be required. However, Impact AQUA-60 would result in significant reductions in  
20 migration habitat conditions. In addition to the benefits provided by the implementation of CM6 and  
21 CM15, the mitigation measures identified below would provide an adaptive management process,  
22 for assessing impacts and developing appropriate minimization measures. This process may be  
23 implemented as a part of the Adaptive Management and Monitoring Program required by the BDCP  
24 (Chapter 3 of the BDCP, Section 3.6). However, the overall effect of Impact AQUA-60 would still be  
25 considered significant and unavoidable.

26 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**  
27 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
28 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

29 Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for  
30 spring-run Chinook salmon.

31 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**  
32 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

33 Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for  
34 spring-run Chinook salmon.

35 **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**  
36 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**  
37 **Conditions Consistent with CM1**

38 Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for  
39 spring-run Chinook salmon.

1 **Restoration and Conservation Measures**

2 The potential effects of restoration measures and other conservation measures on spring-run  
3 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
4 fish effects are anticipated anywhere in the affected environment under Alternative 2B compared to  
5 those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the  
6 effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects  
7 for spring-run Chinook salmon under Alternative 2B.

8 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**  
9 **(Spring-Run ESU)**

10 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**  
11 **Salmon (Spring-Run ESU)**

12 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

13 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
14 **ESU) (CM12)**

15 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
16 **(Spring-Run ESU) (CM13)**

17 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
18 **Run ESU) (CM14)**

19 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
20 **(Spring-Run ESU) (CM15)**

21 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
22 **(CM16)**

23 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
24 **(CM17)**

25 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
26 **(CM18)**

27 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
28 **ESU) (CM19)**

29 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
30 **(Spring-Run ESU) (CM21)**

31 *NEPA Effects:* As discussed for Alternative 1A and 2A, with the implementation of environmental  
32 commitments and conservation measures (Impact AQUA-61 through AQUA-72), the effects would  
33 typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the effects of  
34 contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and  
35 pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are  
36 uncertain.

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, the impact  
2 mechanisms listed above would be beneficial or less than significant, and no mitigation would be  
3 required.

#### 4 **Fall-/Late Fall–Run Chinook Salmon**

5 The potential effects of construction and maintenance of water conveyance facilities, operations of  
6 water conveyance facilities, restoration measures and other conservation measures on fall- and late  
7 fall-run Chinook salmon would be similar to those described under Alternative 1A.

#### 8 **Construction and Maintenance of CM1**

9 The potential effects of construction and maintenance of water conveyance facilities on fall- and late  
10 fall-run Chinook salmon would be similar to those described under Alternative 1A because no  
11 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
12 2B compared to those described in detail for Alternative 1A (Impact AQUA-73 through AQUA-74),  
13 the fish effects described for fall- and late fall-run Chinook salmon under Alternative 1A also  
14 appropriately characterize effects for fall- and late fall-run Chinook salmon under Alternative 2B.

#### 15 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 16 **(Fall-/Late Fall–Run ESU)**

#### 17 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 18 **(Fall-/Late Fall–Run ESU)**

19 **NEPA Effects:** Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
20 would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact  
21 AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of  
22 Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from  
23 impact pile driving (e.g., injury or mortality).

24 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-73  
25 could result in significant underwater noise effects from impact pile driving, although  
26 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
27 impacts to less than significant.

#### 28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

#### 31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

#### 34 **Water Operations of CM1**

35 The potential effects of operations of water conveyance facilities on fall- and late fall-run Chinook  
36 salmon would be similar to those described for Alternative 2A. Because no differences in fish effects  
37 are anticipated anywhere in the affected environment under Alternative 2B compared to those

1 described in detail for Alternative 2A (Impacts AQUA-75 through AQUA-78), the fish effects  
2 described for fall- and late fall-run Chinook salmon also appropriately characterize the effects for  
3 Alternative 2B.

4 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
5 **Fall-Run ESU)**

6 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
7 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

8 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
9 **(Fall-/Late Fall-Run ESU)**

10 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
11 **(Fall-/Late Fall-Run ESU)**

12 **NEPA Effects:** Overall, the effects of water operations vary by location. Similar to effects described in  
13 detail under Alternative 2A, Alternative 2B would have an adverse effect on fall-/late fall-run  
14 Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes. Through-  
15 delta conditions on the Sacramento River would substantially affect migration conditions relative to  
16 NAA while through-Delta conditions on the San Joaquin River would be positive. However, upstream  
17 of the Delta, Alternative 2B conditions relative to NAA would not substantially affect migration  
18 conditions. The implementation of the conservation and mitigation measures listed below, would  
19 reduce the overall effects, but they would still likely remain adverse.

20 **CEQA Conclusion:** As described for Alternative 2A, the differences between the CEQA baseline and  
21 Alternative 2B vary, depending on location. Through-Delta conditions on the Sacramento River  
22 would substantially impact migration conditions relative to Existing Conditions while through-Delta  
23 conditions on the San Joaquin River would be positive relative to Existing Conditions. Upstream of  
24 the Delta conditions relative to Existing Conditions would be reduced although the impacts are  
25 related to climate change. Alternative 2B also has the potential to substantially increase predation  
26 and remove important instream habitat as the result of the presence of five NDD structures.

27 Implementation of *CM6 Channel Margin Enhancement* and *CM15 Localized Reduction of Predatory*  
28 *Fishes (Predator Control)* would address habitat and predation losses, therefore, would potentially  
29 minimize impacts to some extent but not to a less than significant level.

30 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
31 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
32 habitats on the waterside side of levees along channels that provide rearing and outmigration  
33 habitat for juvenile salmonids.

34 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
35 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
36 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. This  
37 conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are  
38 particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment  
39 methods and efficacy, implementation of CM15 would involve discrete pilot projects and  
40 research actions coupled with an adaptive management and monitoring program to evaluate  
41 effectiveness.

1 As with the conservation measures, the implementation of the mitigation measures listed below also  
2 has the potential to reduce the severity of the impact though not necessarily to a less-than-  
3 significant level. These mitigation measures would provide an adaptive management process, that  
4 may be conducted as a part of the Adaptive Management and Monitoring Program required by the  
5 BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate  
6 minimization measures.

7 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
8 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
9 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

10 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for  
11 fall/late fall-run Chinook salmon.

12 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
13 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
14 **of CM1**

15 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for  
16 fall/late fall-run Chinook salmon.

17 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
18 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
19 **Migration Conditions Consistent with CM1**

20 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for  
21 fall/late fall-run Chinook salmon.

22 **Restoration and Conservation Measures**

23 The potential effects of restoration measures and other conservation measures on fall- and late fall-  
24 run Chinook salmon would be similar to those described under Alternative 1A. Because no  
25 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
26 2B compared to those described in detail for Alternative 1A (Impact AQUA-79 through AQUA-90),  
27 the fish effects under Alternative 1A also appropriately characterize effects for fall- and late fall-run  
28 Chinook salmon under Alternative 2B.

29 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**  
30 **(Fall-/Late Fall-Run ESU)**

31 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**  
32 **Salmon (Fall-/Late Fall-Run ESU)**

33 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**  
34 **Run ESU)**

35 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**  
36 **Run ESU) (CM12)**

1 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
2 **(Fall-/Late Fall-Run ESU) (CM13)**

3 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**  
4 **/Late Fall-Run ESU) (CM14)**

5 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
6 **(Fall-/Late Fall-Run ESU) (CM15)**

7 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**  
8 **Run ESU) (CM16)**

9 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**  
10 **ESU) (CM17)**

11 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**  
12 **ESU) (CM18)**

13 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
14 **Fall-Run ESU) (CM19)**

15 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
16 **(Fall-/Late Fall-Run ESU) (CM21)**

17 *NEPA Effects:* As discussed in detail for Alternative 1A, these restoration and conservation  
18 commitment impact mechanisms (Impact AQUA-79 through AQUA-90), would not be adverse, and  
19 would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the  
20 effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper,  
21 ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-  
22 run Chinook salmon are uncertain.

23 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
24 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 25 **Steelhead**

26 The potential effects of construction and maintenance of water conveyance facilities, operations of  
27 water conveyance facilities, restoration measures and other conservation measures on steelhead  
28 would be similar to those described under Alternative 1A.

## 29 **Construction and Maintenance of CM1**

30 The potential effects of construction and maintenance activities on steelhead would be similar to  
31 those described under Alternative 1A because no differences in fish effects are anticipated anywhere  
32 in the affected environment under Alternative 2B compared to those described in detail for  
33 Alternative 1A (Impact AQUA-91 through AQUA-108), the fish effects described for steelhead under  
34 Alternative 1A also appropriately characterize effects for steelhead under Alternative 2B.

1 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

2 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

3 *NEPA Effects:* These impact mechanisms would typically not be adverse to steelhead. While  
4 construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving  
5 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
6 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

7 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-91  
8 could result in significant underwater noise effects from impact pile driving, although  
9 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
10 impacts to less than significant.

11 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
12 **of Pile Driving and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

14 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
15 **and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

17 **Water Operations of CM1**

18 The potential effects of water conveyance facility operations on steelhead would be similar to those  
19 described above under Alternative 2A. Because no differences in fish effects are anticipated  
20 anywhere in the affected environment under Alternative 2B compared to those described in detail  
21 for Alternative 2A (Impact AQUA-93 through AQUA-96), the fish effects described for steelhead  
22 under Alternative 2A also appropriately characterize effects under Alternative 2B.

23 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

24 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
25 **Steelhead**

26 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

27 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

28 *NEPA Effects:* As discussed in detail for Alternative 2A, the above listed impact mechanisms (Impact  
29 AQUA-93 through AQUA-96) flow reductions and temperature increases would affect the quantity  
30 and quality of juvenile rearing habitat and would contribute to reduced survival and increased  
31 stress, particularly in drier water years. This impact is a result of the specific reservoir operations  
32 and resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
33 operations in order to alter the flows) to the extent necessary to reduce this impact would  
34 fundamentally change the alternative, thereby making it a different alternative than that which has  
35 been modeled and analyzed. However, implementing Mitigation Measures AQUA-95a through  
36 AQUA-95c has the potential to reduce the severity of impact though not necessarily to a not adverse  
37 level.

1 **CEQA Conclusion:** Similar to the detailed discussion provided above for Alternative 2A, flow  
2 reductions and temperature increases would have a significant and unavoidable impact on the  
3 quantity and quality of juvenile rearing habitat and would contribute to reduced survival and  
4 increased stress, particularly in drier water years. Applying mitigation (e.g., changing reservoir  
5 operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-  
6 significant level would fundamentally change the alternative, thereby making it a different  
7 alternative than that which has been modeled and analyzed. As a result, this impact is significant and  
8 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation  
9 that has the potential to reduce the severity of impact though not necessarily to a less-than-  
10 significant level.

11 **Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional**  
12 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**  
13 **Reduce Impacts to Rearing Habitat.**

14 Please refer to Mitigation Measure AQUA-95a under Alternative 2A for winter-run Chinook  
15 salmon.

16 **Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts**  
17 **on Steelhead Rearing Habitat Following Initial Operations of CM1.**

18 Please refer to Mitigation Measure AQUA-95b under Alternative 2A for winter-run Chinook  
19 salmon.

20 **Mitigation Measure AQUA-95c: Consult with NMFS, USFWS and CDFW to Identify**  
21 **Potentially Feasible Means to Minimize Effects on Steelhead Habitat Consistent with CM1**

22 Please refer to Mitigation Measure AQUA-95c under Alternative 2A for winter-run Chinook  
23 salmon.

24 **Restoration and Conservation Measures**

25 The potential effects of restoration measures and other conservation measures on steelhead would  
26 be similar to those described under Alternative 1A. Because no differences in fish effects are  
27 anticipated anywhere in the affected environment under Alternative 2B, compared to those  
28 described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the fish effects  
29 described for steelhead also appropriately characterize the effects under Alternative 2B.

30 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

31 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

32 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

33 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

34 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

35 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

1 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

2 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

3 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

4 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

5 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

6 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
7 **(CM21)**

8 **NEPA Effects:** As discussed in detail for Alternative 1A, these impact mechanisms would not be  
9 adverse, and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of  
10 contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be  
11 adverse. The effects of methylmercury on steelhead are uncertain.

12 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A these impact  
13 mechanisms would be beneficial or less than significant, and no mitigation would be required.

14 **Sacramento Splittail**

15 The potential effects of construction and maintenance of water conveyance facilities, operations of  
16 water conveyance facilities, restoration measures and other conservation measures on Sacramento  
17 splittail would be similar to those described under Alternative 1A.

18 **Construction and Maintenance of CM1**

19 The potential effects of construction and maintenance activities on Sacramento splittail would be  
20 similar to those described under Alternative 1A because no differences in fish effects are anticipated  
21 anywhere in the affected environment under Alternative 2B compared to those described in detail  
22 for Alternative 1A (Impact AQUA-109 and AQUA-110), the fish effects described for Sacramento  
23 splittail under Alternative 1A also appropriately characterize effects for Sacramento splittail under  
24 Alternative 2B.

25 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**  
26 **Splittail**

27 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
28 **Splittail**

29 **NEPA Effects:** These impact mechanisms would generally not be adverse to Sacramento splittail.  
30 While construction activities (Impact AQUA-109) could result in adverse effects from impact pile  
31 driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
32 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

33 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-109  
34 could result in significant underwater noise effects from impact pile driving, although  
35 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of

1 impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no  
2 additional mitigation would be required.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

6 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
7 **and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

9 **Water Operations of CM1**

10 The potential effects of water conveyance facility operations on Sacramento splittail would be  
11 similar to those described for Alternative 2A. Because no differences in fish effects are anticipated  
12 anywhere in the affected environment under Alternative 2B, compared to those described in detail  
13 for Alternative 2A (Impacts AQUA-111 through AQUA-114), the fish effects described would also  
14 appropriately characterize the effects under Alternative 2B.

15 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

16 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
17 **Sacramento Splittail**

18 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

19 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
20 **Splittail**

21 *NEPA Effects:* As discussed in detail for Alternative 2A, the operations impact mechanisms would  
22 not be adverse to Sacramento splittail.

23 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 2A, these impact  
24 mechanisms would be less than significant, and no mitigation would be required.

25 **Restoration and Conservation Measures**

26 The potential effects of restoration measures and other conservation measures on Sacramento  
27 splittail would be similar to those described for Alternative 2A. Because no differences in fish effects  
28 are anticipated anywhere in the affected environment under Alternative 2B compared to those  
29 described in detail for Alternative 2A (Impacts AQUA-115 through AQUA-126), the fish effects  
30 described also appropriately characterize the effects under Alternative 2B.

31 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

32 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**  
33 **Sacramento Splittail**

34 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

1 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

2 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**  
3 **Splittail (CM13)**

4 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
5 **(CM14)**

6 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
7 **(CM15)**

8 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

9 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

10 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

11 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

12 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**  
13 **Splittail (CM21)**

14 *NEPA Effects:* As discussed in detail for Alternative 1A, the restoration and conservation measure  
15 impact mechanisms would not be adverse, and would typically be beneficial to Sacramento splittail.  
16 Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect to  
17 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on  
18 Sacramento splittail are uncertain.

19 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, most of these impact  
20 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 21 **Green Sturgeon**

22 The potential effects of construction and maintenance of water conveyance facilities, operations of  
23 water conveyance facilities, restoration measures and other conservation measures on green  
24 sturgeon would be similar to those described under Alternative 1A.

### 25 **Construction and Maintenance of CM1**

26 The potential effects of construction and maintenance activities on Sacramento splittail would be  
27 similar to those described under Alternative 1A because no differences in fish effects are anticipated  
28 anywhere in the affected environment under Alternative 2B compared to those described in detail  
29 for Alternative 1A (Impact AQUA-127 and AQUA-128), the fish effects described for green sturgeon  
30 under Alternative 1A also appropriately characterize effects for green sturgeon under Alternative  
31 2B.

32 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

33 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

1 **NEPA Effects:** While the maintenance impact mechanism (Impact AQUA-128) would not be adverse  
2 to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from  
3 impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and  
4 AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or  
5 mortality).

6 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-127  
7 could result in significant underwater noise effects from impact pile driving, although  
8 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
9 impacts to less than significant. The other impact mechanism would be less than significant, so no  
10 additional mitigation would be required.

11 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
12 **of Pile Driving and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

14 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
15 **and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

17 **Water Operations of CM1**

18 The potential effects of operations of water conveyance facilities on green sturgeon would be similar  
19 to those described for Alternative 2A. Because no differences in fish effects are anticipated  
20 anywhere in the affected environment under Alternative 2B compared to those described in detail  
21 for Alternative 2A (Impacts AQUA-129 through AQUA-132), the fish effects described for green  
22 sturgeon also appropriately characterize the effects under Alternative 2B.

23 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

24 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
25 **Green Sturgeon**

26 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

27 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

28 **NEPA Effects:** As discussed for Alternative 2A, the expected effects of Impact AQUA-130 and Impact  
29 AQUA-132 on green sturgeon spawning and migration habitat under Alternative 2B would be  
30 limited, although adverse effects would still be expected from Impact AQUA-132, because it has the  
31 potential to substantially interfere with the movement of green sturgeon. This effect is a result of the  
32 specific reservoir operations and resulting flows associated with this alternative. Applying  
33 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
34 reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby  
35 making it a different alternative than that which has been modeled and analyzed. Therefore, this  
36 would be an unavoidable adverse effect because there is no feasible mitigation available, although  
37 the implementation of Mitigation Measures AQUA-132a through AQUA-132c, is expected to reduce  
38 the overall effects.

1 As discussed for Alternative 2A, the expected effects of Alternative 2B on green sturgeon  
2 entrainment and rearing habitat (Impact AQUA-129 and Impact AQUA-131) would not be adverse.

3 **CEQA Conclusion:** As discussed in detail for Alternative 2A, Impact AQUA-130 through AQUA-132  
4 could result in significant, but unavoidable, effects on water temperature, and green sturgeon  
5 rearing and migration habitat conditions under Alternative 2B. These impacts are a result of the  
6 specific reservoir operations and resulting flows associated with this alternative. Applying  
7 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
8 reduce this impact to a less-than-significant level would fundamentally change the alternative,  
9 thereby making it a different alternative than that which has been modeled and analyzed. As a  
10 result, these impacts are significant and unavoidable because there is no feasible mitigation  
11 available. Even so, proposed below is mitigation (Mitigation Measure 132a through 132c) that has  
12 the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

13 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**  
14 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**  
15 **Mitigation to Reduce Impacts to Migration Conditions**

16 Please refer to Mitigation Measure AQUA-132a under Alternative 2A.

17 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
18 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

19 Please refer to Mitigation Measure AQUA-132b under Alternative 2A.

20 **Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and**  
21 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
22 **Conditions Consistent with CM1**

23 Please refer to Mitigation Measure AQUA-132c under Alternative 2A.

24 **Restoration and Conservation Measures**

25 The potential effects of restoration measures and other conservation measures on green sturgeon  
26 would be similar to those described under Alternative 1A. Because no differences in fish effects are  
27 anticipated anywhere in the affected environment under Alternative 2B compared to those  
28 described in detail for Alternative 1A (Impact AQUA-133 through AQUA-144), the fish effects under  
29 Alternative 1A would appropriately characterize effects under Alternative 2B.

30 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

31 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**  
32 **Sturgeon**

33 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

34 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

35 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
36 **(CM13)**

1 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

2 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
3 **(CM15)**

4 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

5 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

6 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

7 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

8 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
9 **Sturgeon (CM21)**

10 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, the restoration and  
11 conservation measure impact mechanisms listed above would not be adverse, and would typically  
12 be beneficial to green sturgeon. Specifically for AQUA-134, the effects of contaminants on green  
13 sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of  
14 methylmercury and selenium on green sturgeon are uncertain.

15 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, the impact  
16 mechanisms related to restoration and conservation measures would be beneficial or less than  
17 significant, and no mitigation would be required.

## 18 **White Sturgeon**

19 The potential effects of construction and maintenance of water conveyance facilities, operations of  
20 water conveyance facilities, restoration measures and other conservation measures on white  
21 sturgeon would be similar to those described under Alternative 1A.

### 22 **Construction and Maintenance of CM1**

23 The potential effects of construction and maintenance activities on white sturgeon would be similar  
24 to those described under Alternative 1A because no differences in fish effects are anticipated  
25 anywhere in the affected environment under Alternative 2B compared to those described in detail  
26 for Alternative 1A (Impact AQUA-145 and AQUA-146), the fish effects described for white sturgeon  
27 under Alternative 1A also appropriately characterize effects under Alternative 2B.

28 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

29 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

30 *NEPA Effects:* These impact mechanisms would generally not be adverse to white sturgeon.  
31 However, construction activities (Impact AQUA-145) could result in adverse effects from impact pile  
32 driving activities, although the implementation of Mitigation Measures AQUA-1a and AQUA-1b  
33 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

34 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-145  
35 could result in significant underwater noise effects from impact pile driving, implementation of

1 Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than  
2 significant.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

6 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
7 **and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

9 **Water Operations of CM1**

10 The potential effects of water conveyance operations on white sturgeon would be similar to those  
11 described for Alternative 2A. Because no differences in fish effects are anticipated anywhere in the  
12 affected environment under Alternative 2B compared to those described in detail for Alternative 2A,  
13 the effects described under Alternative 2A (Impacts AQUA-147 through AQUA-150) also  
14 appropriately characterize the effects for white sturgeon under Alternative 2B.

15 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

16 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
17 **White Sturgeon**

18 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

19 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

20 **NEPA Effects:** As discussed above under Alternative 2A, the impact mechanisms listed above would  
21 not be generally adverse for white sturgeon. However, there is a positive correlation between white  
22 sturgeon year class strength and river/Delta flow, such that changes in water operations could  
23 result in an adverse effect on white sturgeon migration conditions (Impact AQUA-150). While there  
24 is uncertainty regarding the particular responsible mechanisms, this uncertainty will be addressed  
25 through targeted research and monitoring conducted in the years leading up to the initiation of  
26 north Delta facilities operations. The results of these efforts would be used to determine if changes  
27 in flow under Alternative 2B are likely to result in adverse effects, as well as to guide an adaptive  
28 management process to minimize or avoid such effects.

29 **CEQA Conclusion:** With a few exceptions, these impact mechanisms listed above would be less than  
30 significant, and no mitigation would be required. As discussed for Impact AQUA-149 under  
31 Alternative 2A, if the expected operational effects are adjusted to exclude sea level rise and climate  
32 change, it would not in itself result in a significant impact on rearing habitat for white sturgeon.  
33 Therefore, this impact is less than significant and no mitigation is required. However, due to the  
34 uncertainty regarding effects of flow changes on migration conditions for white sturgeon (Impact  
35 AQUA-150), research and monitoring efforts and an associated adaptive management process is  
36 proposed. These efforts are expected to identify any significant effects and develop appropriate  
37 mitigation to reduce the effect to be less than significant.

1       **Restoration and Conservation Measures**

2       The potential effects of restoration measures and other conservation measures on white sturgeon  
3       would be similar to those described under Alternative 1A. Because no differences in fish effects are  
4       anticipated anywhere in the affected environment under Alternative 2B compared to those  
5       described in detail for Alternative 1A (Impact AQUA-151 through AQUA-162), the fish effects  
6       described under Alternative 1A appropriately characterize effects for white sturgeon under  
7       Alternative 2B.

8       **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

9       **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**  
10       **Sturgeon**

11       **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

12       **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

13       **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**  
14       **(CM13)**

15       **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

16       **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**  
17       **(CM15)**

18       **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

19       **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

20       **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

21       **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

22       **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**  
23       **Sturgeon (CM21)**

24       **NEPA Effects:** Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
25       would not be adverse to white sturgeon and would typically be beneficial. Specifically for AQUA-152,  
26       the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides  
27       would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

28       **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
29       mechanisms would be beneficial or less than significant, and no mitigation would be required.

30       **Pacific Lamprey**

31       The potential effects of construction and maintenance of water conveyance facilities, operations of  
32       water conveyance facilities, restoration measures and other conservation measures on Pacific  
33       lamprey would be similar to those described under Alternative 1A.

1 **Construction and Maintenance of CM1**

2 The potential effects of construction and maintenance activities on Pacific lamprey would be similar  
3 to those described under Alternative 1A because no differences in fish effects are anticipated  
4 anywhere in the affected environment under Alternative 2B compared to those described in detail  
5 for Alternative 1A (Impact AQUA-163 and AQUA-164), the fish effects described for Pacific lamprey  
6 under Alternative 1A also appropriately characterize effects for Pacific lamprey under Alternative  
7 2B.

8 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

9 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

10 **NEPA Effects:** While maintenance activities would generally not be adverse to Pacific lamprey,  
11 construction activities (Impact AQUA-163) could result in adverse effects from impact pile driving  
12 activities. However, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
13 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

14 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, Impact  
15 AQUA-163 could result in significant underwater noise effects from impact pile driving. However,  
16 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
17 impacts to less than significant.

18 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
19 **of Pile Driving and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
22 **and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

24 **Water Operations of CM1**

25 The potential effects of water conveyance operations on Pacific lamprey would be similar to those  
26 described under Alternative 2A (Impact AQUA-165 and AQUA-168). Because no differences in fish  
27 effects are anticipated anywhere in the affected environment under Alternative 2B compared to  
28 those described in detail for Alternative 2A, the fish effects described for Pacific lamprey under  
29 Alternative 2A also appropriately characterize effects for Pacific lamprey under Alternative 2B.

30 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

31 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
32 **Pacific Lamprey**

33 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

34 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

35 **NEPA Effects:** As discussed for Alternative 2A, these impact mechanisms would not be adverse.

1 **CEQA Conclusion:** Similar to the discussion provided above for 2A, these impact mechanisms would  
2 be less than significant, and no mitigation would be required. While analyses of Impact AQUA-166  
3 and AQUA-167 indicate that the differences between Existing Conditions and Alternative 2A could  
4 be significant because of substantial reductions in suitable spawning and rearing habitat and  
5 increased egg mortality. However, these differences are generally due to climate change, sea level  
6 rise, and future demand, and not the alternative. The impacts of Alternative 2B would be similar, are  
7 would therefore be less than significant and no mitigation is required.

## 8 **Restoration and Conservation Measures**

9 The potential effects of restoration measures and other conservation measures on Pacific lamprey  
10 would be similar to those described under Alternative 1A. Because no differences in fish effects are  
11 anticipated anywhere in the affected environment under Alternative 2B compared to those  
12 described in detail for Alternative 1A (Impact AQUA-169 and through AQUA-180), the fish effects  
13 described for Pacific lamprey under Alternative 1A also appropriately characterize effects for Pacific  
14 lamprey under Alternative 2B.

### 15 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

### 16 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific 17 Lamprey**

### 18 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

### 19 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

### 20 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey 21 (CM13)**

### 22 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

### 23 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey 24 (CM15)**

### 25 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

### 26 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

### 27 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

### 28 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

### 29 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific 30 Lamprey (CM21)**

31 **NEPA Effects:** Similar to the discussion provided above for Alternative 1A these impact mechanisms  
32 would generally not be adverse, and would typically be beneficial to Pacific lamprey.

33 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, these impact  
34 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1 **River Lamprey**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of  
3 water conveyance facilities, restoration measures and other conservation measures on river  
4 lamprey would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance activities on river lamprey would be similar  
7 to those described under Alternative 1A because no differences in fish effects are anticipated  
8 anywhere in the affected environment under Alternative 2B compared to those described in detail  
9 for Alternative 1A (Impact AQUA-181 and AQUA-182), the fish effects described for river lamprey  
10 under Alternative 1A also appropriately characterize effects for river lamprey under Alternative 2B.

11 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

12 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

13 *NEPA Effects:* While construction activities (Impact AQUA-181) could result in adverse effects from  
14 impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b  
15 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).  
16 Therefore, as discussed for Alternative 1A, these impact mechanisms would not be adverse to river  
17 lamprey.

18 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-181  
19 could result in significant underwater noise effects from impact pile driving, implementation of  
20 Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than  
21 significant. Therefore, the overall effects of these impact mechanisms would be less than significant,  
22 so no additional mitigation would be required.

23 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
24 **of Pile Driving and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

26 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
27 **and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

29 **Water Operations of CM1**

30 The potential effects of water conveyance facility operations on river lamprey would be similar to  
31 those described under Alternative 2A. Because no differences in fish effects are anticipated  
32 anywhere in the affected environment under Alternative 2B compared to those described in detail  
33 for Alternative 2A (Impact AQUA-183 through AQUA-186), the fish effects described for river  
34 lamprey under Alternative 2A also appropriately characterize effects for river lamprey under  
35 Alternative 2B.

36 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

1 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **River Lamprey**

3 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

4 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

5 *NEPA Effects:* As discussed for Alternative 2A, these impact mechanisms would not be adverse to  
6 river lamprey.

7 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 2A for river lamprey,  
8 analyses of Impact AQUA-184, AQUA-185, and AQUA-186 indicate that the differences between  
9 Existing Conditions and Alternative 2A could be significant because of substantial reductions in  
10 suitable spawning, incubation, rearing, and migration conditions. However, these differences are  
11 generally due to climate change, sea level rise, and future water demands, and not the alternative.  
12 Thus, the effects of these impact mechanisms under Alternative 2B would be similar to those  
13 discussed under Alternative 2A, and therefore would be less than significant and no mitigation is  
14 required.

15 **Restoration and Conservation Measures**

16 The potential effects of restoration measures and other conservation measures on river lamprey  
17 would be similar to those described under Alternative 1A, as no differences in fish effects are  
18 anticipated anywhere in the affected environment under Alternative 2B (Impact AQUA-187 through  
19 AQUA-198), the fish effects described for river lamprey under Alternative 1A also appropriately  
20 characterize effects for river lamprey under Alternative 2B.

21 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

22 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**  
23 **Lamprey**

24 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

25 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

26 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
27 **(CM13)**

28 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

29 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

30 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

31 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

32 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

33 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

1 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
2 **(CM21)**

3 *NEPA Effects:* As discussed for Alternative 1A, these restoration and conservation measure impact  
4 mechanisms would not be adverse, and would typically be beneficial to river lamprey.

5 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
6 mechanisms would be beneficial or less than significant, and no mitigation would be required.

7 **Non-Covered Aquatic Species of Primary Management Concern**

8 The potential effects of construction and maintenance of water conveyance facilities, operations of  
9 water conveyance facilities, restoration measures and other conservation measures on non-covered  
10 species would be similar to those described under Alternative 1A.

11 **Construction and Maintenance of CM1**

12 The potential effects of construction and maintenance activities on non-covered species would be  
13 similar to those described under Alternative 1A because no differences in fish effects are anticipated  
14 anywhere in the affected environment under Alternative 2B compared to those described in detail  
15 for Alternative 1A (Impact AQUA-199 and AQUA-200), the fish effects described for non-covered  
16 aquatic species of primary management concern under Alternative 1A also appropriately  
17 characterize effects for non-covered aquatic species of primary management concern under  
18 Alternative 2B.

19 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**  
20 **Aquatic Species of Primary Management Concern**

21 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
22 **Aquatic Species of Primary Management Concern**

23 *NEPA Effects:* While construction activities (Impact AQUA-199) could result in adverse effects from  
24 impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b,  
25 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

26 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, while Impact AQUA-  
27 199 could result in significant underwater noise effects from impact pile driving, implementation of  
28 Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than  
29 significant. The other impact mechanism would be less than significant, so no additional mitigation  
30 would be required.

31 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
32 **of Pile Driving and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

34 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
35 **and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

1 **Water Operations of CM1**

2 The potential effects of water conveyance facility operations on non-covered species would be  
3 similar to those described under Alternative 1A, as no differences in fish effects are anticipated  
4 anywhere in the affected environment under Alternative 2B (Impact AQUA-201 through AQUA-204).  
5 Therefore, effects discussed in detail under Alternative 1A also appropriately characterize effects for  
6 non-covered aquatic species of primary management concern under Alternative 2B.

7 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
8 **Species of Primary Management Concern**

9 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
10 **Non-Covered Aquatic Species of Primary Management Concern**

11 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**  
12 **Species of Primary Management Concern**

13 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**  
14 **Aquatic Species of Primary Management Concern**

15 *NEPA Effects:* As discussed for Alternative 2A, the expected effects of Impact AQUA-203 on rearing  
16 habitat for several non-covered fish species of primary management concern under Alternative 2B,  
17 would be reduced, but would not be adverse. These species are Sacramento tule perch, largemouth  
18 bass, hardhead and Sacramento-San Joaquin roach. The other impact mechanisms would not be  
19 adverse.

20 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 2A, most of these impact  
21 mechanisms would be beneficial or less than significant, and no mitigation would be required.  
22 However, Impact AQUA-203 could result in significant, but unavoidable effects on rearing habitat  
23 conditions for several fish species of primary management concern. There are also no feasible  
24 mitigation measures available to mitigate for these impacts. The other impact mechanisms would be  
25 less than significant, so no additional mitigation would be required.

26 **Restoration and Conservation Measures**

27 The potential effects of restoration measures and other conservation measures on non-covered  
28 species would be similar to those described under Alternative 1A, as no differences in fish effects are  
29 anticipated anywhere in the affected environment under Alternative 2B (Impact AQUA-205 through  
30 AQUA-217). Therefore, the fish effects described for non-covered aquatic species of primary  
31 management concern under Alternative 1A also appropriately characterize effects for non-covered  
32 aquatic species of primary management concern under Alternative 2B.

33 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic**  
34 **Species of Primary Management Concern**

35 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**  
36 **Covered Aquatic Species of Primary Management Concern**

37 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**  
38 **Primary Management Concern**

1 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**  
2 **Primary Management Concern (CM12)**

3 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**  
4 **Aquatic Species of Primary Management Concern (CM13)**

5 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**  
6 **Species of Primary Management Concern (CM14)**

7 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**  
8 **Species of Primary Management Concern (CM15)**

9 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**  
10 **Primary Management Concern (CM16)**

11 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**  
12 **Primary Management Concern (CM17)**

13 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**  
14 **Primary Management Concern (CM18)**

15 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**  
16 **of Primary Management Concern (CM19)**

17 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
18 **Aquatic Species of Primary Management Concern (CM21)**

19 *NEPA Effects:* As discussed for Alternative 1A, these impact mechanisms would not be adverse to  
20 the non-covered species of primary management concern.

21 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
22 mechanisms would be beneficial or less than significant, and no mitigation would be required.

23 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
24 **of Pile Driving and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

26 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
27 **and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

29 **Upstream Reservoirs**

30 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

31 *NEPA Effects:* Similar to the description for Alternative 2A, this effect would not be adverse because  
32 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 2B would not be  
33 substantially reduced when compared to NAA.

1       **CEQA Conclusion:** Similar to the description for Alternative 2A, Alternative 2B would reduce the  
2       quantity of coldwater fish habitat in the CVP and SWP. However, if adjusted to exclude sea level rise  
3       and climate change, similar to the NEPA conclusion, the effect would not in itself result in a  
4       significant impact on coldwater habitat in upstream reservoirs. Therefore, this impact is found to be  
5       less than significant and no mitigation is required.

### 11.3.4.7 Alternative 2C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario B)

Alternative 2C would have the same physical/structural water conveyance components and west alignment as Alternative 1C. Overall construction impacts from Alternative 2C would be similar to Alternative 1A but with additional in-water work such as culvert siphons and bridge crossings that are described under Alternative 1C. However, implementation of mitigation measures (described below) and environmental commitments (Appendix 3B, *Environmental Commitments*) would reduce impacts as described under Alternative 1A. Water supply and conveyance operations would follow the guidelines described for Alternative 2A (Operational Scenario B); consequently, the analysis under Alternative 2A is applicable to Alternative 2C.

CM2–CM22 would be implemented under this alternative, and these conservation measures would be identical to those under Alternative 1A. See Chapter 3, *Description of Alternatives*, for additional details on Alternative 2C.

#### Delta Smelt

##### Construction and Maintenance of CM1

Construction of Alternative 2C infrastructure would occur in the same general area as described for Alternative 1A, which includes designated delta smelt critical habitat. Small numbers of delta smelt eggs, larvae, and adults could be present in the in-water construction areas in June and July (see Table 11-4).

##### Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

**NEPA Effects:** The potential effects of construction of water conveyance facilities on delta smelt or critical habitat would be similar to those described under Alternative 1A, Impact AQUA-1. As concluded in Alternative 1A, Impact AQUA-1, the effect would not be adverse for delta smelt.

**CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities on delta smelt or critical habitat would not be significant except for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

##### Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects of Pile Driving and Other Construction-Related Underwater Noise

Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

##### Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise

Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

1 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

2 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
3 Alternative 2C would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
4 AQUA-2). As concluded under Alternative 1A, Impact AQUA-2, the impact would not be adverse for  
5 delta smelt or critical habitat.

6 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-2 for delta smelt, the impact of the  
7 maintenance of water conveyance facilities on delta smelt or critical habitat would be less than  
8 significant and no mitigation is required.

9 **Water Operations of CM1**

10 Operational Scenario B, under Alternative 2C, would be the same as for Alternative 2A. As a result,  
11 there would be no substantial differences between these two alternatives in upstream of the Delta  
12 river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no  
13 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
14 2C compared to those described in detail for Alternative 2A (Impact AQUA-3 through AQUA-6), the  
15 fish effects described for Alternative 2A also appropriately characterize effects under Alternative 2C.

16 The following impacts are those presented under Alternative 2A, which are identical for Alternative  
17 2C.

18 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

19 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
20 **Delta Smelt**

21 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

22 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

23 **NEPA Effects:** With the exception of Impact AQUA-5, the other impact mechanisms listed above,  
24 would not be adverse to delta smelt under Alternative 2C. This is the same conclusion as described  
25 in detail under Alternatives 1A and 2A, and is based on the expected overall limited or slightly  
26 beneficial impacts. However, the overall effect of Impact AQUA-5 on delta smelt rearing habitat  
27 would remain adverse because there likely would still be a loss of suitable habitat even with BDCP  
28 restoration efforts (see Alternative 1A, AQUA-5 for details on expected effects), although the  
29 implementation of restoration and conservation measures may reduce these effects to some extent.

30 **CEQA Conclusion:** The effects of three of the above listed impact mechanisms would be less than  
31 significant, or slightly beneficial to delta smelt, and no mitigation would be required. The effects of  
32 Impact AQUA-5 would also be considered less than significant, because it would not substantially  
33 reduce rearing habitat. Therefore, no mitigation would be required for any of the impact  
34 mechanisms listed above. Detailed discussions regarding these conclusions are presented in  
35 Alternatives 1A and 2A.

36 **Restoration and Conservation Measures**

37 Alternative 2C has the same restoration and conservation measures as Alternative 1A. Because no  
38 substantial differences in fish effects are anticipated anywhere in the affected environment under

1 Alternative 2C compared to those described in detail for Alternative 1A, the effects described for  
2 Alternative 1A (Impact AQUA-7 through AQUA-18) also appropriately characterize effects under  
3 Alternative 2C.

4 The following impacts are those presented under Alternative 1A that are identical for Alternative 2C.

5 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

6 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**  
7 **Smelt**

8 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

9 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

10 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

11 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

12 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

13 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

14 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

15 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

16 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

17 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
18 **(CM21)**

19 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms (Impact AQUA-7  
20 through AQUA-18) would be adverse to delta smelt, and most would be at least slightly beneficial.  
21 Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper,  
22 ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are  
23 uncertain.

24 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or  
25 less than significant, and no mitigation is required.

26 **Longfin Smelt**

27 The potential effects of construction and maintenance of water conveyance facilities, operations of  
28 water conveyance facilities, restoration measures and other conservation measures on longfin smelt  
29 would be similar to those described under Alternative 1A.

30 **Construction and Maintenance of CM1**

31 The potential effects of construction and maintenance activities on longfin smelt would be similar to  
32 those described under Alternative 1A because no differences in fish effects are anticipated anywhere

1 in the affected environment under Alternative 2C compared to those described in detail for  
2 Alternative 1A (Impact AQUA-19 and AQUA-20), the effects described for longfin smelt under  
3 Alternative 1A also appropriately characterize effects for longfin smelt under Alternative 2C.

4 The following impacts on longfin smelt are those presented under Alternative 1A that are identical  
5 for Alternative 2C.

6 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

7 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

8 **NEPA Effects:** As discussed under Alternative 1A, the effects of construction activities (Impact  
9 AQUA-19) could result in adverse effects from impact pile driving activities, although  
10 implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize or eliminate  
11 adverse effects from impact pile driving (e.g., injury or mortality).

12 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, Impact  
13 AQUA-19 could result in significant underwater noise effects from impact pile driving, although  
14 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
15 impacts to less than significant.

16 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
17 **of Pile Driving and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

19 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
20 **and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

22 **Water Operations of CM1**

23 The potential effects of water conveyance facility operations on longfin smelt would be similar to  
24 those described under Alternative 2A. Because no differences in fish effects are anticipated  
25 anywhere in the affected environment under Alternative 2C compared to those described in detail  
26 for Alternative 2A (Impact AQUA-21 through AQUA-24), the effects described for longfin smelt  
27 under Alternative 1A also appropriately characterize effects under Alternative 2C.

28 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

29 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**  
30 **Habitat for Longfin Smelt**

31 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

32 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

33 **NEPA Effects:** As presented under Alternative 2A, the effects of Alternative 2A operations would be  
34 expected to result in 5–6% lower longfin smelt abundance compared to NAA, for all years combined.  
35 Longfin smelt may benefit from habitat restoration actions (*CM2 Yolo Bypass Fisheries Enhancement*

1 *and CM4 Tidal Natural Communities Restoration*, which are intended to provide additional food  
2 production and export to longfin smelt rearing areas in Suisun Marsh, West Delta, and Cache Slough  
3 ROAs.

4 **CEQA Conclusion:** As presented under Alternative 2A, the effects of Alternative 2C operations would  
5 be less than significant for spawning and rearing conditions. The effects on longfin smelt from  
6 reduced entrainment and predation would be beneficial. No mitigation would be required.

#### 7 **Restoration and Conservation Measures**

8 The potential effects of restoration and other conservation measures on longfin smelt would be  
9 similar to those described under Alternative 2A. Because no differences in fish effects are  
10 anticipated anywhere in the affected environment under Alternative 2C compared to those  
11 described in detail for Alternative 2A (Impact AQUA-25 and through AQUA-36), the effects described  
12 for longfin smelt under Alternative 2A also appropriately characterize effects under Alternative 2C.

#### 13 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

#### 14 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin** 15 **Smelt**

#### 16 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

#### 17 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

#### 18 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt** 19 **(CM13)**

#### 20 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

#### 21 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

#### 22 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

#### 23 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

#### 24 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

#### 25 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

#### 26 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt** 27 **(CM21)**

28 **NEPA Effects:** As discussed under Alternative 1A and 2A, the effects of these impact mechanisms  
29 would not be adverse to longfin smelt, and would typically be beneficial. Specifically for AQUA-26,  
30 the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and  
31 pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

32 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact  
33 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1 **Winter-Run Chinook Salmon**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of  
3 water conveyance facilities, restoration measures and other conservation measures on winter-run  
4 Chinook salmon would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance activities on winter-run Chinook salmon  
7 because no differences in fish effects are anticipated anywhere in the affected environment under  
8 Alternative 2C compared to those described in detail for Alternative 1A (Impact AQUA-37 and  
9 AQUA-38), the effects described for winter-run Chinook salmon under Alternative 1A also  
10 appropriately characterize effects under Alternative 2C.

11 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
12 **(Winter-Run ESU)**

13 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
14 **(Winter-Run ESU)**

15 *NEPA Effects:* These impact mechanisms would not be adverse to winter-run Chinook salmon. While  
16 construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving  
17 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
18 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

19 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-37  
20 could result in significant underwater noise effects from impact pile driving, although  
21 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
22 impacts to less than significant.

23 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
24 **of Pile Driving and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

26 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
27 **and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

29 **Water Operations of CM1**

30 The potential effects of water conveyance facility operations on winter-run Chinook salmon would  
31 be similar to those described under Alternative 2A. Because no differences in fish effects are  
32 anticipated anywhere in the affected environment under Alternative 2C compared to those  
33 described in detail for Alternative 2A (Impact AQUA-39 and through AQUA-42), the effects on  
34 winter-run Chinook salmon described for Alternative 2A, also appropriately characterize effects  
35 under Alternative 2C.

36 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**  
37 **Run ESU)**

1 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Chinook Salmon (Winter-Run ESU)**

3 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
4 **(Winter-Run ESU)**

5 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
6 **(Winter-Run ESU)**

7 *NEPA Effects:* As discussed for Alternative 2A, the impact mechanisms listed above could be adverse  
8 to winter-run Chinook salmon under Alternative 2C. The effects could be adverse because of the  
9 potential to substantially reduce suitable spawning and rearing habitat, the number of fish as a  
10 result of egg mortality, as well as overall migration conditions. These effects are a result of the  
11 specific reservoir operations and resulting flows associated with this alternative. Applying  
12 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
13 reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby  
14 making it a different alternative than that which has been modeled and analyzed. As a result, this  
15 would be an unavoidable adverse effect because there is no feasible mitigation available. However,  
16 implementing Mitigation Measure AQUA-40a through AQUA-40c and AQUA-41a through AQUA-41c  
17 has the potential to reduce the severity of impact though not necessarily to a not adverse level.

18 *CEQA Conclusion:* As discussed in detail under Alternative 2A, the effects under Alternative 2C  
19 would be significant because it has the potential to substantially reduce suitable spawning and  
20 rearing habitat, reduce the number of fish as a result of egg mortality, and reducing the overall  
21 migration habitat conditions. These effects are a result of the specific reservoir operations and  
22 resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
23 operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-  
24 significant level would fundamentally change the alternative, thereby making it a different  
25 alternative than that which has been modeled and analyzed. As a result, this impact is significant and  
26 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation  
27 that has the potential to reduce the severity of impact though not necessarily to a less-than-  
28 significant level.

29 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional**  
30 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
31 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

32 Please refer to Mitigation Measure AQUA-40a under Impact AQUA-40 of Alternative 2A.

33 **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts**  
34 **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

35 Please refer to Mitigation Measure AQUA-40b under Impact AQUA-40 of Alternative 2A.

36 **Mitigation Measure AQUA-40c: Consult with NMFS, USFWS, and CDFW to Identify and**  
37 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
38 **Salmon Spawning Habitat Consistent with CM1**

39 Please refer to Mitigation Measure AQUA-40c under Impact AQUA-40 of Alternative 2A.

1       **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**  
2       **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**  
3       **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

4       Please refer to Mitigation Measure AQUA-41a under Impact AQUA-41 of Alternative 2A.

5       **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**  
6       **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

7       Please refer to Mitigation Measure AQUA-41b under Impact AQUA-41 of Alternative 2A.

8       **Mitigation Measure AQUA-41c: Consult with NMFS, USFWS, and CDFW to Identify and**  
9       **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
10       **Salmon Rearing Habitat Consistent with CM1**

11       Please refer to Mitigation Measure AQUA-41c under Impact AQUA-41 of Alternative 2A.

12       **Restoration and Conservation Measures**

13       The potential effects of restoration measures and other conservation measures on winter-run  
14       Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
15       fish effects are anticipated anywhere in the affected environment under Alternative 2B compared to  
16       those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects  
17       described for winter-run Chinook salmon under Alternative 1A also appropriately characterize  
18       effects under Alternative 2C.

19       **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
20       **(Winter-Run ESU)**

21       **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
22       **Salmon (Winter-Run ESU)**

23       **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
24       **ESU)**

25       **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
26       **ESU) (CM12)**

27       **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
28       **(Winter-Run ESU) (CM13)**

29       **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
30       **Run ESU) (CM14)**

31       **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
32       **(Winter-Run ESU) (CM15)**

33       **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
34       **(CM16)**

1 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
2 **(CM17)**

3 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
4 **(CM18)**

5 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
6 **ESU) (CM19)**

7 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
8 **(Winter-Run ESU) (CM21)**

9 *NEPA Effects:* As discussed for Alternative 1A and 2A, the restoration and conservation measure  
10 impact mechanisms would not be adverse, and would typically be beneficial to winter-run Chinook  
11 salmon. Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with  
12 respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of  
13 methylmercury on winter-run Chinook salmon are uncertain.

14 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 2A, these  
15 restoration and conservation measure impact mechanisms would be beneficial or less than  
16 significant, and no mitigation would be required.

17 **Spring-Run Chinook Salmon**

18 The potential effects of construction and maintenance of water conveyance facilities, operations of  
19 water conveyance facilities, restoration measures and other conservation measures on spring-run  
20 Chinook salmon would be similar to those described under Alternative 1A.

21 **Construction and Maintenance of CM1**

22 The potential effects of construction and maintenance activities on spring-run Chinook salmon  
23 would be similar to those described under Alternative 1A because no differences in fish effects are  
24 anticipated anywhere in the affected environment under Alternative 2C compared to those  
25 described in detail for Alternative 1A (Impact AQUA-55 and AQUA-56), the effects described for  
26 spring-run Chinook salmon under Alternative 1A also appropriately characterize effects under  
27 Alternative 2C.

28 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
29 **(Spring-Run ESU)**

30 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
31 **(Spring-Run ESU)**

32 *NEPA Effects:* These impact mechanisms would not be adverse to spring-run Chinook salmon. While  
33 construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving  
34 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
35 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternatives 1A and 2A, Impact  
2 AQUA-55 could result in significant underwater noise effects from impact pile driving, although  
3 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
4 impacts to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

11 **Water Operations of CM1**

12 The potential effects of water conveyance facility operations on spring-run Chinook salmon would  
13 be similar to those described under Alternative 2A. Because no differences in fish effects are  
14 anticipated anywhere in the affected environment under Alternative 2C compared to Alternative 2A  
15 (Impact AQUA-57 through AQUA-60), the fish effects described for spring-run Chinook salmon  
16 under Alternatives 2A also appropriately characterize effects under Alternative 2C.

17 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
18 **ESU)**

19 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
20 **Chinook Salmon (Spring-Run ESU)**

21 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**  
22 **Run ESU)**

23 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
24 **(Spring-Run ESU)**

25 **NEPA Effects:** As discussed in detail for Alternative 2A, except for Impact AQUA-60, the impact  
26 mechanisms listed above would not be adverse to spring-run Chinook salmon under Alternative 2C.  
27 However, adverse effects would occur from Impact AQUA-60 because habitat and migration  
28 conditions for juvenile spring-run Chinook salmon would be substantially reduced, and because it  
29 has the potential to substantially increase predation and remove important instream habitat as the  
30 result of the presence of five north Delta intake structures. The implementation of conservation and  
31 mitigation measures would reduce the severity of effects, although not necessarily to a not adverse  
32 level.

33 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 2A, three of the impact  
34 mechanisms listed above would be less than significant under Alternative 2C, so no additional  
35 mitigation would be required. However, Impact AQUA-60 would result in significant reductions in  
36 migration habitat conditions. In addition to the benefits provided by the implementation of CM6 and  
37 CM15, the mitigation measures identified below would provide an adaptive management process,  
38 for assessing impacts and developing appropriate minimization measures. This process may be

1 implemented as a part of the Adaptive Management and Monitoring Program required by the BDCP  
2 (Chapter 3 of the BDCP, Section 3.6). However, the overall effect of Impact AQUA-60 would still be  
3 considered significant and unavoidable.

4 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**  
5 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
6 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

7 Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for  
8 spring-run Chinook salmon.

9 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**  
10 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

11 Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for  
12 spring-run Chinook salmon.

13 **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**  
14 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**  
15 **Conditions Consistent with CM1**

16 Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for  
17 spring-run Chinook salmon.

18 **Restoration and Conservation Measures**

19 The potential effects of restoration measures and other conservation measures on spring-run  
20 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in  
21 fish effects are anticipated anywhere in the affected environment under Alternative 2C, compared to  
22 those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the  
23 effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects  
24 for spring-run Chinook salmon under Alternative 2C.

25 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**  
26 **(Spring-Run ESU)**

27 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**  
28 **Salmon (Spring-Run ESU)**

29 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

30 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
31 **ESU) (CM12)**

32 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
33 **(Spring-Run ESU) (CM13)**

34 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
35 **Run ESU) (CM14)**

1 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
2 **(Spring-Run ESU) (CM15)**

3 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
4 **(CM16)**

5 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
6 **(CM17)**

7 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
8 **(CM18)**

9 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
10 **ESU) (CM19)**

11 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
12 **(Spring-Run ESU) (CM21)**

13 *NEPA Effects:* As discussed for Alternative 1A and 2A, with the implementation of environmental  
14 commitments and conservation measures (Impact AQUA-61 through AQUA-72), the effects would  
15 typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the effects of  
16 contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and  
17 pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are  
18 uncertain.

19 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 2A, these impact  
20 mechanisms would be beneficial or less than significant, and no mitigation would be required.

21 **Fall-/Late Fall–Run Chinook Salmon**

22 The potential effects of construction and maintenance of water conveyance facilities, operations of  
23 water conveyance facilities, restoration measures and other conservation measures on fall- and late  
24 fall-run Chinook salmon would be similar to those described under Alternative 1A.

25 **Construction and Maintenance of CM1**

26 The potential effects of construction and maintenance activities on fall- and late fall-run Chinook  
27 salmon would be similar to those described under Alternative 1A because no differences in fish  
28 effects are anticipated anywhere in the affected environment under Alternative 2C compared to  
29 those described in detail for Alternative 1A (Impact AQUA-73 through AQUA-74), the effects  
30 described for fall- and late fall-run Chinook salmon under Alternative 1A also appropriately  
31 characterize effects under Alternative 2C.

32 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
33 **(Fall-/Late Fall–Run ESU)**

34 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
35 **(Fall-/Late Fall–Run ESU)**

36 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
37 would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact

1 AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of  
2 Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from  
3 impact pile driving (e.g., injury or mortality).

4 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-73  
5 could result in significant underwater noise effects from impact pile driving, although  
6 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
7 impacts to less than significant.

8 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
9 **of Pile Driving and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

11 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
12 **and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

14 **Water Operations of CM1**

15 The potential effects of operations of water conveyance facilities on fall- and late fall-run Chinook  
16 salmon would be similar to those described for Alternative 2A. Because no differences in fish effects  
17 are anticipated anywhere in the affected environment under Alternative 2C compared to those  
18 described in detail for Alternative 2A (Impacts AQUA-75 through AQUA-78), the fish effects  
19 described for fall- and late fall-run Chinook salmon also appropriately characterize the effects for  
20 Alternative 2C.

21 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
22 **Fall-Run ESU)**

23 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
24 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

25 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
26 **(Fall-/Late Fall-Run ESU)**

27 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
28 **(Fall-/Late Fall-Run ESU)**

29 **NEPA Effects:** Overall, the effects of water operations vary by location. Similar to effects described in  
30 detail under Alternative 2A, Alternative 2C would have an adverse effect on fall-/late fall-run  
31 Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes. Through-  
32 delta conditions on the Sacramento River would substantially affect migration conditions relative to  
33 NAA while through-Delta conditions on the San Joaquin River would be positive. However, upstream  
34 of the Delta, Alternative 2C conditions relative to NAA would not substantially affect migration  
35 conditions. The implementation of the conservation and mitigation measures listed below, would  
36 reduce the overall effects, but they would still likely remain adverse.

37 **CEQA Conclusion:** As described for Alternative 2A, the differences between the CEQA baseline and  
38 Alternative 2C vary, depending on location. Through-Delta conditions on the Sacramento River

1 would substantially impact migration conditions relative to Existing Conditions while through-Delta  
2 conditions on the San Joaquin River would be positive relative to Existing Conditions. Upstream of  
3 the Delta conditions relative to Existing Conditions would be reduced although the impacts are  
4 related to climate change. Alternative 2C also has the potential to substantially increase predation  
5 and remove important instream habitat as the result of the presence of five NDD structures.

6 Implementation of *CM6 Channel Margin Enhancement* and *CM15 Localized Reduction of Predatory*  
7 *Fishes (Predator Control)* would address habitat and predation losses, therefore, would potentially  
8 minimize impacts to some extent but not to a less than significant level.

9 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of  
10 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat  
11 habitats on the waterside side of levees along channels that provide rearing and outmigration  
12 habitat for juvenile salmonids.

13 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to  
14 reduce populations of predatory fishes at specific locations or modify holding habitat at selected  
15 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. This  
16 conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are  
17 particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment  
18 methods and efficacy, implementation of CM15 would involve discrete pilot projects and  
19 research actions coupled with an adaptive management and monitoring program to evaluate  
20 effectiveness.

21 As with the conservation measures, the implementation of the mitigation measures listed below also  
22 has the potential to reduce the severity of the impact though not necessarily to a less-than-  
23 significant level. These mitigation measures would provide an adaptive management process, that  
24 may be conducted as a part of the Adaptive Management and Monitoring Program required by the  
25 BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate  
26 minimization measures.

27 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
28 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
29 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

30 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for  
31 fall/late fall-run Chinook salmon.

32 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
33 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
34 **of CM1**

35 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for  
36 fall/late fall-run Chinook salmon.

37 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
38 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
39 **Migration Conditions Consistent with CM1**

40 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for  
41 fall/late fall-run Chinook salmon.

1 **Restoration and Conservation Measures**

2 The potential effects of restoration measures and other conservation measures on fall- and late fall-  
3 run Chinook salmon would be similar to those described under Alternative 1A. Because no  
4 differences in fish effects are anticipated anywhere in the affected environment under Alternative  
5 2C compared to those described in detail for Alternative 1A (Impact AQUA-79 through AQUA-90),  
6 the fish effects under Alternative 1A also appropriately characterize effects for fall- and late fall-run  
7 Chinook salmon under Alternative 2C.

8 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**  
9 **(Fall-/Late Fall-Run ESU)**

10 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**  
11 **Salmon (Fall-/Late Fall-Run ESU)**

12 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**  
13 **Run ESU)**

14 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**  
15 **Run ESU) (CM12)**

16 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
17 **(Fall-/Late Fall-Run ESU) (CM13)**

18 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**  
19 **/Late Fall-Run ESU) (CM14)**

20 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
21 **(Fall-/Late Fall-Run ESU) (CM15)**

22 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**  
23 **Run ESU) (CM16)**

24 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**  
25 **ESU) (CM17)**

26 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**  
27 **ESU) (CM18)**

28 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
29 **Fall-Run ESU) (CM19)**

30 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
31 **(Fall-/Late Fall-Run ESU) (CM21)**

32 *NEPA Effects:* As discussed in detail for Alternative 1A, these restoration and conservation  
33 commitment impact mechanisms (Impact AQUA-79 through AQUA-90) would not be adverse, and  
34 would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the  
35 effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper,

1 ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-  
2 run Chinook salmon are uncertain.

3 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, these impact  
4 mechanisms would be beneficial or less than significant, and no mitigation would be required.

## 5 **Steelhead**

6 The potential effects of construction and maintenance of water conveyance facilities, operations of  
7 water conveyance facilities, restoration measures and other conservation measures on steelhead  
8 would be similar to those described under Alternative 1A.

### 9 **Construction and Maintenance of CM1**

10 The potential effects of construction and maintenance activities on steelhead would be similar to  
11 those described under Alternative 1A because no differences in fish effects are anticipated anywhere  
12 in the affected environment under Alternative 2C compared to those described in detail for  
13 Alternative 1A (Impact AQUA-91 through AQUA-108), the fish effects described for steelhead under  
14 Alternative 1A also appropriately characterize effects for steelhead under Alternative 2C.

### 15 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

### 16 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

17 **NEPA Effects:** These impact mechanisms would typically not be adverse to steelhead. While  
18 construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving  
19 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or  
20 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

21 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-91  
22 could result in significant underwater noise effects from impact pile driving, although  
23 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
24 impacts to less than significant.

### 25 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 26 **of Pile Driving and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

### 28 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 29 **and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

### 31 **Water Operations of CM1**

32 The potential effects of water conveyance facility operations on steelhead would be similar to those  
33 described above under Alternative 2A. Because no differences in fish effects are anticipated  
34 anywhere in the affected environment under Alternative 2C compared to those described in detail  
35 for Alternative 2A (Impact AQUA-93 through AQUA-96), the effects described for steelhead under  
36 Alternative 2A also appropriately characterize effects under Alternative 2C.

1 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

2 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
3 **Steelhead**

4 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

5 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

6 **NEPA Effects:** As discussed in detail for Alternative 2A for the above listed impact mechanisms  
7 (Impact AQUA-93 through AQUA-96) flow reductions and temperature increases under Alternative  
8 2C would affect the quantity and quality of juvenile rearing habitat and would contribute to reduced  
9 survival and increased stress. This impact is a result of the specific reservoir operations and  
10 resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
11 operations in order to alter the flows) to the extent necessary to reduce this impact would  
12 fundamentally change the alternative, thereby making it a different alternative than that which has  
13 been modeled and analyzed. However, implementing Mitigation Measures AQUA-95a through  
14 AQUA-95c has the potential to reduce the severity of impact though not necessarily to a not adverse  
15 level.

16 **CEQA Conclusion:** Similar to the detailed discussion provided above for Alternative 2A, flow  
17 reductions and temperature increases would have a significant and unavoidable impact on the  
18 quantity and quality of juvenile rearing habitat and would contribute to reduced survival and  
19 increased stress. Applying mitigation to reduce this impact to a less-than-significant level would  
20 fundamentally change the alternative, thereby making it a different alternative than that which has  
21 been modeled and analyzed. As a result, this impact is significant and unavoidable because there is  
22 no feasible mitigation available. Even so, proposed below is mitigation that has the potential to  
23 reduce the severity of impact though not necessarily to a less-than-significant level.

24 **Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional**  
25 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**  
26 **Reduce Impacts to Rearing Habitat.**

27 Please refer to Mitigation Measure AQUA-95a under Alternative 2A for winter-run Chinook  
28 salmon.

29 **Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts**  
30 **on Steelhead Rearing Habitat Following Initial Operations of CM1.**

31 Please refer to Mitigation Measure AQUA-95b under Alternative 2A for winter-run Chinook  
32 salmon.

33 **Mitigation Measure AQUA-95c: Consult with NMFS, USFWS and CDFW to Identify**  
34 **Potentially Feasible Means to Minimize Effects on Steelhead Habitat Consistent with CM1**

35 Please refer to Mitigation Measure AQUA-95c under Alternative 2A for winter-run Chinook  
36 salmon.

1 **Restoration and Conservation Measures**

2 The potential effects of restoration measures and other conservation measures on steelhead would  
3 be similar to those described under Alternative 1A. Because no differences in fish effects are  
4 anticipated anywhere in the affected environment under Alternative 2C, compared to those  
5 described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the effects described  
6 for steelhead also appropriately characterize the effects under Alternative 2C.

7 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

8 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

9 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

10 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

11 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

12 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

13 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

14 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

15 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

16 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

17 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

18 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
19 **(CM21)**

20 **NEPA Effects:** As discussed in detail for Alternative 1A and 2A, these impact mechanisms would not  
21 be adverse, and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of  
22 contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be  
23 adverse. The effects of methylmercury on steelhead are uncertain.

24 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, these impact  
25 mechanisms would be beneficial or less than significant, and no mitigation would be required.

26 **Sacramento Splittail**

27 The potential effects of construction and maintenance of water conveyance facilities, operations of  
28 water conveyance facilities, restoration measures and other conservation measures on Sacramento  
29 splittail would be similar to those described under Alternative 1A.

30 **Construction and Maintenance of CM1**

31 The potential effects of construction and maintenance activities on Sacramento splittail would be  
32 similar to those described under Alternative 1A because no differences in fish effects are anticipated

1 anywhere in the affected environment under Alternative 2C compared to those described in detail  
2 for Alternative 1A (Impact AQUA-109 and AQUA-110), the fish effects described for Sacramento  
3 splittail under Alternative 1A also appropriately characterize effects for Sacramento splittail under  
4 Alternative 2C.

5 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**  
6 **Splittail**

7 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
8 **Splittail**

9 *NEPA Effects:* These impact mechanisms would generally not be adverse to Sacramento splittail.  
10 While construction activities (Impact AQUA-109) could result in adverse effects from impact pile  
11 driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
12 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

13 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-109  
14 could result in significant underwater noise effects from impact pile driving, although  
15 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
16 impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no  
17 additional mitigation would be required.

18 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
19 **of Pile Driving and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
22 **and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

24 **Water Operations of CM1**

25 The potential effects of water conveyance facility operations on Sacramento splittail would be  
26 similar to those described for Alternative 2A. Because no differences in fish effects are anticipated  
27 anywhere in the affected environment under Alternative 2C, compared to those described in detail  
28 for Alternative 2A (Impacts AQUA-111 through AQUA-114), the fish effects described would also  
29 appropriately characterize the effects under Alternative 2C.

30 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

31 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
32 **Sacramento Splittail**

33 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

34 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
35 **Splittail**

1 **NEPA Effects:** As discussed in detail for Alternative 2A, the operations impact mechanisms would  
2 not be adverse to Sacramento splittail.

3 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 2A, these impact  
4 mechanisms would be less than significant, and no mitigation would be required.

#### 5 **Restoration and Conservation Measures**

6 The potential effects of restoration measures and other conservation measures on Sacramento  
7 splittail would be similar to those described for Alternative 2A. Because no differences in fish effects  
8 are anticipated anywhere in the affected environment under Alternative 2C compared to those  
9 described in detail for Alternative 2A (Impacts AQUA-115 through AQUA-126), the fish effects  
10 described also appropriately characterize the effects under Alternative 2C.

#### 11 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

#### 12 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on** 13 **Sacramento Splittail**

#### 14 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

#### 15 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

#### 16 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento** 17 **Splittail (CM13)**

#### 18 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail** 19 **(CM14)**

#### 20 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail** 21 **(CM15)**

#### 22 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

#### 23 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

#### 24 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

#### 25 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

#### 26 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento** 27 **Splittail (CM21)**

28 **NEPA Effects:** As discussed in detail for Alternative 1A and 2A, the restoration and conservation  
29 measure impact mechanisms would not be adverse, and would typically be beneficial to Sacramento  
30 splittail. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect  
31 to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on  
32 Sacramento splittail are uncertain.

33 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, these impact  
34 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1 **Green Sturgeon**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of  
3 water conveyance facilities, restoration measures and other conservation measures on green  
4 sturgeon would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance activities on green sturgeon would be similar  
7 to those described under Alternative 1A because no differences in fish effects are anticipated  
8 anywhere in the affected environment under Alternative 2C compared to those described in detail  
9 for Alternative 1A (Impact AQUA-127 and AQUA-128), the effects described for green sturgeon  
10 under Alternative 1A also appropriately characterize effects for green sturgeon under Alternative  
11 2C.

12 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

13 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

14 *NEPA Effects:* While the maintenance impact mechanism (Impact AQUA-128) would not be adverse  
15 to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from  
16 impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and  
17 AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or  
18 mortality).

19 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-127  
20 could result in significant underwater noise effects from impact pile driving, although  
21 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
22 impacts to less than significant. The other impact mechanism would be less than significant, so no  
23 additional mitigation would be required.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

30 **Water Operations of CM1**

31 The potential effects of operations of water conveyance facilities on green sturgeon would be similar  
32 to those described for Alternative 2A. Because no differences in fish effects are anticipated  
33 anywhere in the affected environment under Alternative 2C compared to those described in detail  
34 for Alternative 2A (Impacts AQUA-129 through AQUA-132), the fish effects described for green  
35 sturgeon also appropriately characterize the effects under Alternative 2C.

1 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

2 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
3 **Green Sturgeon**

4 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

5 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

6 *NEPA Effects:* As discussed for Alternative 2A, the expected effects of Impact AQUA-130 and Impact  
7 AQUA-132 on green sturgeon spawning and migration habitat under Alternative 2C would be  
8 limited, although adverse effects would still be expected from Impact AQUA-132, because it has the  
9 potential to substantially interfere with the movement of green sturgeon. This effect is a result of the  
10 specific reservoir operations and resulting flows associated with this alternative. Applying  
11 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
12 reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby  
13 making it a different alternative than that which has been modeled and analyzed. Therefore, this  
14 would be an unavoidable adverse effect because there is no feasible mitigation available, although  
15 the implementation of Mitigation Measures AQUA-132a through AQUA-132c, is expected to reduce  
16 the overall effects.

17 As discussed for Alternative 2A, the expected effects of Alternative 2C on green sturgeon  
18 entrainment and rearing habitat (Impact AQUA-129 and Impact AQUA-131) would not be adverse.

19 *CEQA Conclusion:* As discussed in detail for Alternative 2A, Impact AQUA-130 through AQUA-132  
20 could result in significant, but unavoidable, effects on water temperature, and green sturgeon  
21 rearing and migration habitat conditions under Alternative 2C. These impacts are a result of the  
22 specific reservoir operations and resulting flows associated with this alternative. Applying  
23 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
24 reduce this impact to a less-than-significant level would fundamentally change the alternative,  
25 thereby making it a different alternative than that which has been modeled and analyzed. As a  
26 result, these impacts are significant and unavoidable because there is no feasible mitigation  
27 available. Even so, proposed below is mitigation (Mitigation Measure 132a through 132c) that has  
28 the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

29 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**  
30 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**  
31 **Mitigation to Reduce Impacts to Migration Conditions**

32 Please refer to Mitigation Measure AQUA-132a under Alternative 2A.

33 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
34 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

35 Please refer to Mitigation Measure AQUA-132b under Alternative 2A.

36 **Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and**  
37 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
38 **Conditions Consistent with CM1**

39 Please refer to Mitigation Measure AQUA-132c under Alternative 2A.

1       **Restoration and Conservation Measures**

2       The potential effects of restoration measures and other conservation measures on green sturgeon  
3       would be similar to those described under Alternative 1A. Because no differences in fish effects are  
4       anticipated anywhere in the affected environment under Alternative 2C compared to those  
5       described in detail for Alternative 1A (Impact AQUA-133 through AQUA-144), the fish effects under  
6       Alternative 1A would appropriately characterize effects under Alternative 2C.

7       **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

8       **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**  
9       **Sturgeon**

10       **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

11       **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

12       **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
13       **(CM13)**

14       **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

15       **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
16       **(CM15)**

17       **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

18       **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

19       **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

20       **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

21       **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
22       **Sturgeon (CM21)**

23       **NEPA Effects:** Similar to the discussion provided above for Alternative 1A, the restoration and  
24       conservation measure impact mechanisms listed above would not be adverse, and would typically  
25       be beneficial to green sturgeon. Specifically for AQUA-134, the effects of contaminants on green  
26       sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of  
27       methylmercury and selenium on green sturgeon are uncertain.

28       **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, the impact  
29       mechanisms related to restoration and conservation measures would be beneficial or less than  
30       significant, and no mitigation would be required.

31       **White Sturgeon**

32       The potential effects of construction and maintenance of water conveyance facilities, operations of  
33       water conveyance facilities, restoration measures and other conservation measures on white  
34       sturgeon would be similar to those described under Alternative 1A.

1       **Construction and Maintenance of CM1**

2       The potential effects of construction and maintenance activities on white sturgeon would be similar  
3       to those described under Alternative 1A because no differences in fish effects are anticipated  
4       anywhere in the affected environment under Alternative 2C compared to those described in detail  
5       for Alternative 1A (Impact AQUA-145 and AQUA-146), the fish effects described for white sturgeon  
6       under Alternative 1A also appropriately characterize effects under Alternative 2C.

7       **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

8       **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

9       *NEPA Effects:* These impact mechanisms would generally not be adverse to white sturgeon.  
10       However, construction activities (Impact AQUA-145) could result in adverse effects from impact pile  
11       driving activities, although the implementation of Mitigation Measures AQUA-1a and AQUA-1b  
12       would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

13       *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-145  
14       could result in significant underwater noise effects from impact pile driving, implementation of  
15       Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than  
16       significant.

17       **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
18       **of Pile Driving and Other Construction-Related Underwater Noise**

19       Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

20       **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
21       **and Other Construction-Related Underwater Noise**

22       Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

23       **Water Operations of CM1**

24       The potential effects of water conveyance operations on white sturgeon would be similar to those  
25       described for Alternative 2A. Because no differences in fish effects are anticipated anywhere in the  
26       affected environment under Alternative 2C compared to those described in detail for Alternative 2A,  
27       the effects described under Alternative 2A (Impacts AQUA-147 through AQUA-150) also  
28       appropriately characterize the effects for white sturgeon under Alternative 2C.

29       **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

30       **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
31       **White Sturgeon**

32       **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

33       **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

34       *NEPA Effects:* As discussed above under Alternative 2A, the impact mechanisms listed above would  
35       not be generally adverse for white sturgeon. However, there is a positive correlation between white  
36       sturgeon year class strength and river/Delta flow, such that changes in water operations could

1 result in an adverse effect on white sturgeon migration conditions (Impact AQUA-150). While there  
2 is uncertainty regarding the particular responsible mechanisms, this uncertainty will be addressed  
3 through targeted research and monitoring conducted in the years leading up to the initiation of  
4 north Delta facilities operations. The results of these efforts would be used to determine if changes  
5 in flow under Alternative 2C are likely to result in adverse effects, as well as to guide an adaptive  
6 management process to minimize or avoid such effects.

7 **CEQA Conclusion:** With a few exceptions, these impact mechanisms listed above would be less than  
8 significant, and no mitigation would be required. As discussed for Impact AQUA-149 under  
9 Alternative 2A, if the expected operational effects are adjusted to exclude sea level rise and climate  
10 change, it would not in itself result in a significant impact on rearing habitat for white sturgeon.  
11 Therefore, this impact is less than significant and no mitigation is required. However, due to the  
12 uncertainty regarding effects of flow changes on migration conditions for white sturgeon (Impact  
13 AQUA-150), research and monitoring efforts and an associated adaptive management process is  
14 proposed. These efforts are expected to identify any significant effects and develop appropriate  
15 mitigation to reduce the effect to be less than significant.

#### 16 **Restoration and Conservation Measures**

17 The potential effects of restoration measures and other conservation measures on white sturgeon  
18 would be similar to those described under Alternative 1A. Because no differences in fish effects are  
19 anticipated anywhere in the affected environment under Alternative 2C compared to those  
20 described in detail for Alternative 1A (Impact AQUA-151 through AQUA-162), the effects described  
21 under Alternative 1A appropriately characterize effects for white sturgeon under Alternative 2C.

#### 22 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

#### 23 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 24 **Sturgeon**

#### 25 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

#### 26 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

#### 27 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon** 28 **(CM13)**

#### 29 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

#### 30 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon** 31 **(CM15)**

#### 32 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

#### 33 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

#### 34 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

#### 35 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

1 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**  
2 **Sturgeon (CM21)**

3 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
4 would not be adverse to white sturgeon and would typically be beneficial. Specifically for AQUA-152,  
5 the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides  
6 would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

7 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact  
8 mechanisms would be beneficial or less than significant, and no mitigation would be required.

9 **Pacific Lamprey**

10 The potential effects of construction and maintenance of water conveyance facilities, operations of  
11 water conveyance facilities, restoration measures and other conservation measures on Pacific  
12 lamprey would be similar to those described under Alternative 1A.

13 **Construction and Maintenance of CM1**

14 The potential effects of construction and maintenance activities on Pacific lamprey would be similar  
15 to those described under Alternative 1A because no differences in fish effects are anticipated  
16 anywhere in the affected environment under Alternative 2C compared to those described in detail  
17 for Alternative 1A (Impact AQUA-163 and AQUA-164), the fish effects described for Pacific lamprey  
18 under Alternative 1A also appropriately characterize effects for Pacific lamprey under Alternative  
19 2C.

20 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

21 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

22 *NEPA Effects:* While maintenance activities would generally not be adverse to Pacific lamprey,  
23 construction activities (Impact AQUA-163) could result in adverse effects from impact pile driving  
24 activities. However, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would  
25 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

26 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 2A, Impact  
27 AQUA-163 could result in significant underwater noise effects from impact pile driving. However,  
28 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of  
29 impacts to less than significant.

30 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
31 **of Pile Driving and Other Construction-Related Underwater Noise**

32 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

33 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
34 **and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

1 **Water Operations of CM1**

2 The potential effects of water conveyance operations on Pacific lamprey would be similar to those  
3 described under Alternative 2A (Impact AQUA-165 and AQUA-168). Because no differences in fish  
4 effects are anticipated anywhere in the affected environment under Alternative 2C compared to  
5 those described in detail for Alternative 2A, the effects described for Pacific lamprey under  
6 Alternative 2A also appropriately characterize effects for Pacific lamprey under Alternative 2C.

7 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

8 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
9 **Pacific Lamprey**

10 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

11 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

12 *NEPA Effects:* As discussed for Alternative 2A, these impact mechanisms would not be adverse to  
13 Pacific lamprey.

14 *CEQA Conclusion:* Similar to the discussion provided above for 2A, these impact mechanisms would  
15 be less than significant, and no mitigation would be required. While analyses of Impact AQUA-166  
16 and AQUA-167 indicate that the differences between Existing Conditions and Alternative 2A could  
17 be significant because of substantial reductions in suitable spawning and rearing habitat and  
18 increased egg mortality. However, these differences are generally due to climate change, sea level  
19 rise, and future demand, and not the alternative. The impacts of Alternative 2C would be similar, and  
20 would therefore be less than significant and no mitigation is required.

21 **Restoration and Conservation Measures**

22 The potential effects of restoration measures and other conservation measures on Pacific lamprey  
23 would be similar to those described under Alternative 1A. Because no differences in effects are  
24 anticipated anywhere in the affected environment under Alternative 2C compared to those  
25 described in detail for Alternative 1A (Impact AQUA-169 and through AQUA-180), the effects  
26 described for Pacific lamprey under Alternative 1A also appropriately characterize effects for Pacific  
27 lamprey under Alternative 2C.

28 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

29 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**  
30 **Lamprey**

31 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

32 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

33 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**  
34 **(CM13)**

35 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

1 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**  
2 **(CM15)**

3 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

4 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

5 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

6 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

7 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
8 **Lamprey (CM21)**

9 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, these impact mechanisms  
10 would not be adverse, and would typically be beneficial to Pacific lamprey.

11 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 2A, most of these  
12 impact mechanisms would be beneficial or less than significant, and no mitigation would be  
13 required.

14 **River Lamprey**

15 The potential effects of construction and maintenance of water conveyance facilities, operations of  
16 water conveyance facilities, restoration measures and other conservation measures on river  
17 lamprey would be similar to those described under Alternative 1A.

18 **Construction and Maintenance of CM1**

19 The potential effects of construction and maintenance activities on river lamprey would be similar  
20 to those described under Alternative 1A because no differences in fish effects are anticipated  
21 anywhere in the affected environment under Alternative 2C compared to those described in detail  
22 for Alternative 1A (Impact AQUA-181 and AQUA-182), the fish effects described for river lamprey  
23 under Alternative 1A also appropriately characterize effects for river lamprey under Alternative 2C.

24 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

25 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

26 *NEPA Effects:* While construction activities (Impact AQUA-181) could result in adverse effects from  
27 impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b  
28 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).  
29 Therefore, as discussed for Alternative 1A, these impact mechanisms would not be adverse to river  
30 lamprey.

31 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-181  
32 could result in significant underwater noise effects from impact pile driving, implementation of  
33 Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than  
34 significant. Therefore, the overall effects of these impact mechanisms would be less than significant,  
35 so no additional mitigation would be required.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

4           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5           **and Other Construction-Related Underwater Noise**

6           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

7           **Water Operations of CM1**

8           The potential effects of water conveyance facility operations on river lamprey would be similar to  
9           those described under Alternative 2A. Because no differences in fish effects are anticipated  
10          anywhere in the affected environment under Alternative 2C compared to those described in detail  
11          for Alternative 2A (Impact AQUA-183 through AQUA-186), the effects described for river lamprey  
12          under Alternative 2A also appropriately characterize effects for river lamprey under Alternative 2C.

13          **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

14          **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
15          **River Lamprey**

16          **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

17          **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

18          *NEPA Effects:* As discussed for Alternative 2A, these impact mechanisms would not be adverse to  
19          river lamprey.

20          *CEQA Conclusion:* Similar to the discussion provided above under Alternative 2A for river lamprey,  
21          analyses of Impact AQUA-184, AQUA-185, and AQUA-186 indicate that the differences between  
22          Existing Conditions and Alternative 2A could be significant because of substantial reductions in  
23          suitable spawning, incubation, rearing, and migration conditions. However, these differences are  
24          generally due to climate change, sea level rise, and future water demands, and not the alternative.  
25          Thus, the effects of these impact mechanisms under Alternative 2C would be similar to those  
26          discussed above under Alternative 2A, and therefore would be less than significant and no  
27          mitigation is required.

28          **Restoration and Conservation Measures**

29          The potential effects of restoration measures and other conservation measures on river lamprey  
30          would be similar to those described under Alternative 1A, as no differences in fish effects are  
31          anticipated anywhere in the affected environment under Alternative 2C (Impact AQUA-187 through  
32          AQUA-198), the effects described for river lamprey under Alternative 1A also appropriately  
33          characterize effects for river lamprey under Alternative 2C.

34          **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

35          **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**  
36          **Lamprey**

1 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

2 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

3 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
4 **(CM13)**

5 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

6 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

7 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

8 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

9 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

10 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

11 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
12 **(CM21)**

13 *NEPA Effects:* As discussed for Alternative 1A and 2A, these restoration and conservation measure  
14 impact mechanisms would not be adverse, and would typically be beneficial to river lamprey.

15 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 2A, these impact  
16 mechanisms would be beneficial or less than significant, and no mitigation would be required.

### 17 **Non-Covered Aquatic Species of Primary Management Concern**

18 The potential effects of construction and maintenance of water conveyance facilities, operations of  
19 water conveyance facilities, restoration measures and other conservation measures on non-covered  
20 species would be similar to those described under Alternative 1A.

#### 21 **Construction and Maintenance of CM1**

22 The potential effects of construction and maintenance activities on non-covered species would be  
23 similar to those described under Alternative 1A because no differences in fish effects are anticipated  
24 anywhere in the affected environment under Alternative 2C compared to those described in detail  
25 for Alternative 1A (Impact AQUA-199 and AQUA-200), the fish effects described for non-covered  
26 aquatic species of primary management concern under Alternative 1A also appropriately  
27 characterize effects for non-covered aquatic species of primary management concern under  
28 Alternative 2C.

29 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**  
30 **Aquatic Species of Primary Management Concern**

31 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
32 **Aquatic Species of Primary Management Concern**

1 **NEPA Effects:** While construction activities (Impact AQUA-199) could result in adverse effects from  
2 impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b,  
3 would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

4 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, while Impact AQUA-  
5 199 could result in significant underwater noise effects from impact pile driving, implementation of  
6 Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than  
7 significant. The other impact mechanism would be less than significant, so no additional mitigation  
8 would be required.

9 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
10 **of Pile Driving and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

12 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
13 **and Other Construction-Related Underwater Noise**

14 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

15 **Water Operations of CM1**

16 The potential effects of water conveyance facility operations on non-covered species would be  
17 similar to those described under Alternative 1A, as no differences in fish effects are anticipated  
18 anywhere in the affected environment under Alternative 2C (Impact AQUA-201 through AQUA-204).  
19 Therefore, effects discussed in detail under Alternative 1A also appropriately characterize effects for  
20 non-covered aquatic species of primary management concern under Alternative 2C.

21 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
22 **Species of Primary Management Concern**

23 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
24 **Non-Covered Aquatic Species of Primary Management Concern**

25 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**  
26 **Species of Primary Management Concern**

27 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**  
28 **Aquatic Species of Primary Management Concern**

29 **NEPA Effects:** As discussed for Alternative 2A, the expected effects of Impact AQUA-203 on rearing  
30 habitat for several non-covered fish species of primary management concern under Alternative 2C,  
31 would be reduced, but would not be adverse. These species are Sacramento tule perch, largemouth  
32 bass, hardhead and Sacramento-San Joaquin roach. The other impact mechanisms would not be  
33 adverse.

34 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 2A, most of these impact  
35 mechanisms would be beneficial or less than significant, and no mitigation would be required.  
36 However, Impact AQUA-203 could result in significant, but unavoidable effects on rearing habitat  
37 conditions for several fish species of primary management concern. There are also no feasible

1 mitigation measures available to mitigate for these impacts. The other impact mechanisms would be  
2 less than significant, so no additional mitigation would be required.

### 3 **Restoration and Conservation Measures**

4 The potential effects of restoration measures and other conservation measures on non-covered  
5 species would be similar to those described under Alternative 1A, as no differences in fish effects are  
6 anticipated anywhere in the affected environment under Alternative 2C (Impact AQUA-205 through  
7 AQUA-217). Therefore, the fish effects described for non-covered aquatic species of primary  
8 management concern under Alternative 1A also appropriately characterize effects for non-covered  
9 aquatic species of primary management concern under Alternative 2C.

#### 10 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic** 11 **Species of Primary Management Concern**

#### 12 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-** 13 **Covered Aquatic Species of Primary Management Concern**

#### 14 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of** 15 **Primary Management Concern**

#### 16 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of** 17 **Primary Management Concern (CM12)**

#### 18 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered** 19 **Aquatic Species of Primary Management Concern (CM13)**

#### 20 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic** 21 **Species of Primary Management Concern (CM14)**

#### 22 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic** 23 **Species of Primary Management Concern (CM15)**

#### 24 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of** 25 **Primary Management Concern (CM16)**

#### 26 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of** 27 **Primary Management Concern (CM17)**

#### 28 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of** 29 **Primary Management Concern (CM18)**

#### 30 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species** 31 **of Primary Management Concern (CM19)**

#### 32 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered** 33 **Aquatic Species of Primary Management Concern (CM21)**

1 **NEPA Effects:** As discussed for Alternative 1A, these impact mechanisms would not be adverse to  
2 the non-covered species of primary management concern, and with the implementation of  
3 environmental commitments and conservation measures, the effects would typically be beneficial.

4 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 2A, most of these  
5 impact mechanisms would be beneficial or less than significant, and no mitigation would be  
6 required.

## 7 **Upstream Reservoirs**

### 8 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

9 **NEPA Effects:** Similar to the description for Alternative 2A, this effect would not be adverse because  
10 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 2C would not be  
11 substantially reduced when compared to NAA.

12 **CEQA Conclusion:** Similar to the description for Alternative 2A, Alternative 2C would reduce the  
13 quantity of coldwater fish habitat in the CVP and SWP. However, if adjusted to exclude sea level rise  
14 and climate change, similar to the NEPA conclusion, the effect would not in itself result in a  
15 significant impact on coldwater habitat in upstream reservoirs. Therefore, this impact is found to be  
16 less than significant and no mitigation is required.

### 11.3.4.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and Intakes 1 and 2 (6,000 cfs; Operational Scenario A)

Alternative 3 would result in the same potential construction impacts as Alternative 1A, except that only Intakes 1 and 2 would be constructed. Consequently, the intensity and extent of impacts related to the construction of the intakes would be similar but less under Alternative 3 compared to those under Alternative 1A. The total permanent in-water footprint of the two intakes would be about 8.3 acres (13.5 acres smaller under Alternative 3 than under Alternative 1A), and the total length of permanent bank protection would be approximately 4,450 feet (7,450 feet less than Alternative 1A) (See Table 11-7). The six barge landings under Alternative 3 would be in the same locations, and operate the same as the landings under Alternative 1A. The effects of the landing construction and operation would be identical to those described for Alternative 1A. All other upland construction, except for the pipelines between Intakes 1 and 2 and the intermediate forebay, are identical to Alternative 1A. The conveyance system would be the same under Alternative 3 as under Alternative 1A; therefore, all impacts related to construction of the conveyance tunnel and pipelines, including those associated with barge landings would be the same. All other aspects of construction would be similar but typically less than for Alternative 3 as for Alternative 1A.

The Sacramento River channel and bank would be affected by construction of the two north Delta intake facilities (Intakes 1 and 2) between RM 44 (south of Freeport) and approximately RM 39 (at the town of Courtland). The locations, dimensions, and construction footprints of the intakes considered in Alternative 3 are presented in Table 11-5.

The number of barge trips required under Alternative 3 would be somewhat less than the estimated 3,000 barge trips under Alternative 1A, because two intake facilities would be constructed under Alternative 3 compared to five intakes under Alternative 1A. All other aspects of construction would typically be less under Alternative 3 as described for Alternative 1A.

## Delta Smelt

### Construction and Maintenance of CM1

#### Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

The potential effects of construction of water conveyance facilities on delta smelt or designated critical habitat under Alternative 3 would be the same as those described for Alternative 1A (see Impact AQUA-1), except that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 4,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of contaminated sediments would be similar to Alternative 1A and the same environmental commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential effects.

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and  
2 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
3 not be adverse for delta smelt or critical habitat.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-1, the impact of the construction of  
5 water conveyance facilities on delta smelt or critical habitat would be less than significant except for  
6 construction noise associated with pile driving. Potential pile driving impacts would be less than  
7 Alternative 1A because only two intakes would be constructed rather than five. Implementation of  
8 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact to  
9 less than significant.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
13 Alternative 1A.

14 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
15 **and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
17 Alternative 1A.

18 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

19 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
20 Alternative 3 would be the same as those described for Alternative 1A (see Impact AQUA-2) except  
21 that only two intakes would need to be maintained under Alternative 3 rather than five as under  
22 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the effect on delta smelt or critical  
23 habitat would not be adverse.

24 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-2, the impact of the maintenance of  
25 water conveyance facilities on delta smelt would be less than significant and no mitigation would be  
26 required.

27 **Water Operations of CM1**

28 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

29 **Water Exports from SWP/CVP South Delta Facilities**

30 Under Alternative 3, average proportional entrainment would increase for larvae and juveniles  
31 (Figure 11-3-1), and decrease for adults (Figure 11-3-2).

32 Proportional entrainment of larval/juvenile delta smelt (March-June) under Alternative 3 would  
33 average 0.16(16% of the juvenile population) (Figure 11-3-1). This is an increase of 0.013 (1.3% of  
34 the juvenile population, a 9% relative increase) compared to NAA (Table 11-3-1). The greatest  
35 increase would occur in above normal years (0.024 more proportional entrainment, a 22% relative  
36 increase compared to NAA).

37 For adult delta smelt (December-March), average proportional entrainment would be no greater  
38 than 0.08 (i.e., 8% of the adult population) (Figure 11-3-2). Proportional entrainment under

1 Alternative 3 would be reduced compared to NAA for all water year types (average 0.010 lower, a  
2 13% relative decrease), with the greatest reduction in wet (28% relative decrease) and above  
3 normal years (14% relative decrease) (Figure 11-3-2, Table 11-3-1).

4 **Table 11-3-1. Differences in Proportional Entrainment Index of Delta Smelt at SWP/CVP South**  
5 **Delta Facilities**

Water Year Type	Proportional Entrainment <sup>a</sup> Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A3_LL <sup>T</sup>	NAA vs. A3_LL <sup>T</sup>
<b>Total Population (December–June)</b>		
Wet	0.011 (10%)	-0.015 (-11%)
Above Normal	0.041 (25%)	0.013 (7%)
Below Normal	0.043 (20%)	0.014 (5%)
Dry	0.030 (11%)	0.011 (4%)
Critical	0.012 (4%)	0.013 (4%)
All Years	0.025 (13%)	0.004 (2%)
<b>Juvenile Delta Smelt (March–June)</b>		
Wet	0.031 (81%)	0.005 (7%)
Above Normal	0.053 (65%)	0.024 (22%)
Below Normal	0.052 (38%)	0.020 (12%)
Dry	0.034 (19%)	0.014 (7%)
Critical	0.019 (8%)	0.014 (6%)
All Years	0.037 (30%)	0.013 (9%)
<b>Adult Delta Smelt<sup>b</sup> (December–March)</b>		
Wet	-0.020 (-29%)	-0.019 (-28%)
Above Normal	-0.012 (-15%)	-0.011 (-14%)
Below Normal	-0.008 (-10%)	-0.006 (-8%)
Dry	-0.004 (-6%)	-0.003 (-4%)
Critical	-0.007 (-9%)	-0.001 (-2%)
All Years	-0.012 (-15%)	-0.010 (-13%)

Shading indicates 5% or more increase in entrainment.

Note: Negative values indicate lower entrainment loss under Alternative than under existing biological conditions.

<sup>a</sup> Proportional entrainment index calculated in accordance with USFWS BiOp (U.S. Fish and Wildlife Service 2008a).

<sup>b</sup> Adult proportional entrainment adjusted according to Kimmerer (2011).

6

7 **Water Exports from SWP/CVP North Delta Intake Facilities**

8 As described for Alternative 1A, potential entrainment and impingement risks at the proposed north  
9 Delta facilities would be limited since delta smelt rarely occur in the vicinity of the proposed intake  
10 site. The intake would be screened to exclude fish larger than 15 mm SL. Alternative 3 would have  
11 only two intakes, and therefore potential entrainment and impingement risks would be even lower  
12 than for Alternative 1A with five intakes (0–2% particle entrainment).

**Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

Potential entrainment of larval delta smelt at the NBA, as estimated by particle tracking modeling, was low, averaging 1.3% under Alternative 3 compared to 2.0% under NAA (a 35% relative decrease) (Table 11-3-2).

**Table 11-3-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 3 and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A3_LLТ	A3_LLТ vs. EXISTING CONDITIONS	A3_LLТ vs. NAA
2.1	2.0	1.3	-0.80 (-38%)	-0.70 (-35%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario.

**Predation Associated with Entrainment**

Pre-screen loss of delta smelt at the south Delta facilities is typically attributed to predation (as described in Impact AQUA-3 for Alternative 1) and is expected to change commensurate with changes in entrainment. Predation risk at the proposed north Delta intake screens and structures would be very low because delta smelt rarely occur this far upstream and risk associated with the dual conveyance option of the NBA would likely be low because this alternative intake on the Sacramento is located upstream of the main delta smelt range.

**NEPA Effects:** In summation, under Alternative 3 average proportional entrainment at the south Delta facilities would increase slightly for larval/juvenile delta smelt and decrease for adults, but this change would be a small proportion of the population. Any potential effects would be reduced by real-time monitoring and adaptive management response by the Real-Time Response Team. Entrainment and impingement could potentially occur at the proposed north Delta intakes, but the risk would be low due to the location, design, and operation of intakes, and offset by reduced entrainment at the south Delta facilities.

Overall, the effect of Alternative 3 on entrainment at SWP/CVP facilities would not be adverse due to the minimal amount and risk.

**CEQA Conclusion:** Under Alternative 3, average proportional entrainment for adults would decrease 0.012 (15% relative decrease), with the greatest decrease in wet years (0.020 less, 29% relative decrease) (Table 11-3-1, Figure 11-3-2). Average larval/juvenile proportional entrainment and associated predation loss at the south Delta facilities would increase 0.037 (a 30% relative increase) compared to Existing Conditions, with greatest increase in above normal (0.053 more, 65% relative increase) and wet years (0.031 more, 81% relative increase) (Table 11-3-1, Figure 11-3-1). However, this represents a small proportion of the larval/juvenile population (3.7% on average, 5.3% in above normal years). Furthermore, as described for Alternative 1A (Impact AQUA-3), monitoring and adaptive management by the Real-Time Response Team would reduce such modeled potential impacts.

Note that the CEQA interpretation of the larval/juvenile proportional entrainment differs from the NEPA analysis, which is likely due to different modeling assumptions (as described in Section 11.3.3

1 and Alternative 1A Impact AQUA-3). Because the action alternative modeling does not partition the  
2 effects of implementation of the alternative from the effects of sea level rise, climate change and  
3 future water demands, the comparison to Existing Conditions may not offer a clear understanding of  
4 the impact of the alternative on the environment. Note that the analysis for larvae and juveniles  
5 includes both OMR flows and X2 as predictors of proportional entrainment; primarily because of sea  
6 level rise assumptions, X2 would be further upstream in the ELT and LLT even with similar water  
7 operations, so that the comparison of the action alternative in the ELT and LLT to Existing  
8 Conditions is confounded.

9 Therefore, the impact analysis is better informed by the results from the NEPA analysis presented  
10 above, which accounts for sea level rise by considering the NAA in the LLT. When climate change is  
11 factored in, larval-juvenile delta smelt proportional entrainment would still increase compared to  
12 conditions without BDCP, but to a smaller degree: 0.013 more entrainment (a 9% relative increase)  
13 averaged across all years, and 0.024 more entrainment (22% relative increase) in above normal  
14 years (Table 11-2A-1). This represents a small proportion of the modeled larval-juvenile population  
15 (1.3% average, 2.4% in above normal water years)

16 The proposed north Delta intake facilities have the potential for entrainment and impingement, but  
17 this risk would be minimized due to low abundances of delta smelt in the vicinity, fewer intakes  
18 (two intakes for Alternative 3), and state-of-the-art screens. Potential entrainment of larvae would  
19 be slightly decreased (1%) at the NBA compared to Existing Conditions (Table 11-3-2).

20 Overall, the impact is considered less than significant because overall entrainment of delta smelt  
21 would be similar to conditions without BDCP, and only a small proportion of the population would  
22 be affected. Furthermore, any potential impacts would be reduced by monitoring and adaptive  
23 management by the Real-Time Response Team. No mitigation would be required.

#### 24 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 25 **Delta Smelt**

26 **NEPA Effects:** The effects of operations under Alternative 3 on abiotic spawning habitat would be  
27 about the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north  
28 Delta intakes would not reduce available spawning habitat. In-Delta water temperatures, which can  
29 affect spawning timing, would not change across alternatives, because they would be in thermal  
30 equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect  
31 of Alternative 3 operations on spawning would not be adverse, because there would be little change  
32 in abiotic spawning conditions for delta smelt.

33 **CEQA Conclusion:** Operations under Alternative 3 would not reduce abiotic spawning habitat  
34 availability or change spawning temperatures for delta smelt (see discussion in Alternative 1A,  
35 Impact AQUA-4). Consequently, the impact would be less than significant, and no mitigation would  
36 be required.

#### 37 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

38 **NEPA Effects:** As described for Alternative 1A (Impact AQUA-5), rearing habitat conditions for  
39 juvenile delta smelt are considered with respect to a fall abiotic habitat index with and without the  
40 assumption that habitat restoration benefits are realized. Similar to Alternative 1A, Alternative 3

1 does not include the USFWS BiOp Fall X2 requirements. The average abiotic habitat index under  
2 Alternative 3 without restoration (A3\_LL1T would be 21% less, relative to NAA (Table 11-3-3).

3 However, habitat restoration has the potential to increase spawning and rearing habitat and is  
4 expected to supplement food production and export to rearing areas. With habitat restoration,  
5 Alternative 3 could provide delta smelt with additional habitat (CM2, CM4,) particularly in the  
6 Suisun Marsh, West Delta, and Cache Slough ROAs, which are closer to delta smelt's main range. The  
7 average abiotic habitat index for Alternative 3 with habitat restoration would be about the same as  
8 NAA assuming 100% habitat occupancy by delta smelt. Under Alternative 3 the delta smelt abiotic  
9 habitat index without restoration would remain fairly constant (~5,000 hectares) across wet to  
10 below normal water year types (Figure 11-3-3).

11 Assuming habitat benefits are realized, the abiotic habitat index under Alternative 3 would be 25%  
12 lower than NAA in wet water year types, 8% lower in above normal water year types, but 24–35%  
13 greater than baseline in other water year types (Table 11-3-3).

14 **CEQA Conclusion:** As discussed under Alternative 1A, Alternative 3 would not result in less rearing  
15 habitat area, compared to Existing Conditions. However, without BDCP habitat restoration efforts,  
16 the delta smelt fall abiotic habitat index under Alternative 3 would be similar under most water year  
17 types (about 4% difference) compared to Existing Conditions. In wet water years, the abiotic habitat  
18 index would decrease 13% in wet water years, but would be the same or slightly increased relative  
19 to Existing Conditions in all other water year types. With the implementation of the BDCP habitat  
20 restoration actions, the average abiotic habitat index under Alternative 3 would increase by 22%  
21 compared to Existing Conditions. The abiotic habitat index would increase 22% on average (10–  
22 32% more in wetter years and 24–32% more in drier years) compared to Existing Conditions.

23 Note that the CEQA analysis predicts a greater increase in the abiotic habitat index relative to  
24 baseline than the NEPA analysis. It is unclear whether this increase under Alternative 3 compared to  
25 Existing Conditions is a function of Project operations, or attributable to differences in modeling  
26 assumptions (Existing Conditions does not include Fall X2). The NEPA analysis is a better approach  
27 for isolating the effect of the Alternative from the effects of sea level rise, climate change, future  
28 water demands, and implementation of required actions under the BiOps. When compared to the  
29 NAA and informed by the NEPA analysis, the average delta smelt abiotic habitat index under  
30 Alternative 3 without restoration would be 21% lower to NAA, and similar to NAA with restoration  
31 (Table 11-3-3).

32 Overall, there would be a minor beneficial impact on the species compared to existing conditions  
33 without Fall X2, primarily from implementation of habitat restoration. The benefits of restored  
34 habitat for this species will depend on the success of restoration in creating physical habitat for  
35 smelt and in fostering ecological conditions that favor good feeding conditions and production of  
36 food upon which smelt can feed. The magnitude of restored habitat benefits is uncertain. As such,  
37 BDCP water operations will be subject to adjustment via adaptive management, in order to ensure  
38 the impacts of water operations on rearing habitat for delta smelt are not significant and to support  
39 a contribution to recovery of this species. The Adaptive Management Program will evaluate the  
40 effects of water operations and habitat restoration on the delta smelt population, including  
41 adjustments as appropriate to improve water supply reliability. In conclusion, the impact of  
42 Alternative 3 without habitat restoration on delta smelt rearing habitat would be considered less  
43 than significant, because the amount of abiotic habitat would be similar to Existing Conditions. The

1 impact would be less than significant and may be beneficial when habitat restoration is included. No  
2 mitigation would be required.

3 **Table 11-3-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 3 and**  
4 **Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
All	-147 (-4%)	-1,033 (-21%)	867 (22%)	-18 (0%)
Wet	-632 (-13%)	-2,828 (-41%)	462 (10%)	-1,734 (-25%)
Above Normal	135 (4%)	-1,533 (-28%)	1,224 (32%)	-443 (-8%)
Below Normal	-3 (0%)	146 (4%)	1,130 (27%)	1,278 (32%)
Dry	157 (4%)	249 (7%)	1,132 (32%)	1,224 (35%)
Critical	18 (1%)	17 (1%)	713 (24%)	713 (24%)

Shading indicates >5% decrease in estimated abiotic habitat acres from baseline.

Note: Negative values indicate lower habitat indices under preliminary proposal scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

5

6 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

7 **NEPA Effects:** As described for previous alternatives, Alternative 3 may decrease sediment supply to  
8 the estuary by 8 to 9%, with the potential for decreased habitat suitability for delta smelt in some  
9 locations.

10 **CEQA Conclusion:** Operations under Alternative 3 would not substantially alter the turbidity cues  
11 associated with winter flush events that may initiate migration, nor would there be appreciable  
12 changes in water temperatures (see Alternative 1A, Impact AQUA-6). Consequently, the impact on  
13 adult delta smelt migration conditions would be less than significant, and no mitigation would be  
14 required.

15 **Restoration Measures (CM2, CM4–CM7, and CM10)**

16 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
17 differences in restoration-related effects on fish are anticipated anywhere in the affected  
18 environment under Alternative 3 compared to those described in detail for Alternative 1A, the  
19 effects of restoration measures on fish as described for delta smelt under Alternative 1A (Impact  
20 AQUA-7 through AQUA-9) also appropriately characterize effects under Alternative 3.

21 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

22 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

23 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**  
24 **Smelt**

25 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

1 **NEPA Effects:** All of these impact mechanisms have been determined to result in no adverse effects  
2 on delta smelt, for the reasons identified for Alternative 1A. Specifically for AQUA-8, the effects of  
3 contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be  
4 adverse. The effects of methylmercury on delta smelt are uncertain.

5 **CEQA Conclusion:** All of these impact mechanisms would be considered less than significant, for the  
6 reasons identified for Alternative 1A, and no mitigation would be required.

#### 7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
9 differences in other conservation-related effects on fish are anticipated anywhere in the affected  
10 environment under Alternative 3 compared to those described in detail for Alternative 1A, the  
11 effects of other conservation measures on fish described for delta smelt under Alternative 1A  
12 (Impact AQUA-10 through AQUA-18) also appropriately characterize effects under Alternative 3.

13 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

14 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

15 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

16 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

17 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

18 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

19 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

20 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

21 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

22 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
23 **(CM21)**

24 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
25 adverse effect, or beneficial effects on delta smelt for NEPA purposes, for the reasons identified for  
26 Alternative 1A.

27 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
28 less than significant, or beneficial on delta smelt, for the reasons identified for Alternative 1A, and no  
29 mitigation is required.

## 1 Longfin Smelt

### 2 Construction and Maintenance of CM1

#### 3 Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

4 The potential effects of construction of water conveyance facilities on longfin smelt under  
5 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-19) except  
6 that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the  
7 effects would be proportionally less under this alternative. This would convert about 4,450 lineal  
8 feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of  
9 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
10 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
11 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
12 contaminated sediments would be similar to Alternative 1A and the same environmental  
13 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
14 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
15 effects.

16 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-19, environmental commitments and  
17 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
18 not be adverse for longfin smelt.

19 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-19, the impact of the construction of  
20 water conveyance facilities on longfin smelt would be less than significant except for construction  
21 noise associated with pile driving which would only occur for two intakes rather than five.  
22 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the  
23 noise impact to less than significant.

#### 24 Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects 25 of Pile Driving and Other Construction-Related Underwater Noise

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
27 Alternative 1A.

#### 28 Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving 29 and Other Construction-Related Underwater Noise

30 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
31 Alternative 1A.

#### 32 Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt

33 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
34 Alternative 3 would be the same as those described for Alternative 1A except that only two intakes  
35 would need to be maintained under Alternative 3 instead of five as under Alternative 1A (see Impact  
36 AQUA-20). As concluded in Alternative 1A, Impact AQUA-20, the effect on longfin smelt would not be  
37 adverse.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-20, the impact of the maintenance  
2 of water conveyance facilities on longfin smelt would be less than significant and no mitigation  
3 would be required.

4 **Water Operations of CM1**

5 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

6 **Water Exports from SWP/CVP South Delta Facilities**

7 For larval longfin smelt, entrainment risk was simulated using particle tracking modeling.  
8 Entrainment loss of longfin smelt larvae to the south Delta facilities under the wetter starting  
9 distribution was 1.1% for Alternative 3 compared to 1.6% for NAA, a 35% decrease in relative terms  
10 (Table 11-3-4). Under the drier starting distribution, average entrainment was 1.4% under  
11 Alternative 3 compared to 2.2% for NAA, a 38% relative decline. Overall, larval longfin smelt  
12 entrainment at the south Delta intakes would be reduced under Alternative 3 compared to baseline  
13 conditions (NAA).

14 **Table 11-3-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**  
15 **Entrained by the South Delta Facilities under Alternative 3 and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A3_LLTT	A3_LLTT vs. EXISTING CONDITIONS	A3_LLTT vs. NAA
Wetter	1.9	1.6	1.1	-0.77 (-41%)	-0.59 (-35%)
Drier	2.5	2.2	1.4	-1.13 (-45%)	-0.86 (-38%)

16  
17 For juvenile longfin smelt, entrainment at the south Delta facilities (salvage index, averaged across  
18 all water year types) would increase under Alternative 3 by 61% (compared to NAA) (Table 11-3-5).  
19 The increase in juvenile entrainment is related to substantial increases in reverse OMR flows in  
20 April and May during dry and wetter water year types. Under Alternative 3, juvenile entrainment  
21 would be highest in dry water year types. In critical water year types, juvenile entrainment would be  
22 reduced 11% compared to NAA.

23 For adult longfin smelt, entrainment at the south Delta facilities (salvage index, averaged across all  
24 water year types) would be reduced by 29% compared to NAA (Table 11-3-5). The reduction in  
25 entrainment for adult longfin smelt is due to substantial reductions in reverse OMR flows during  
26 January–March under Alternative 3 (Figure 11-3-1). For adult longfin smelt, the reduction in  
27 entrainment is 1–2 orders of magnitude greater in critical years. Under Alternative 3, adult  
28 entrainment in critical water year types would be reduced 22% compared to NAA.

1 **Table 11-3-5. Longfin Smelt Entrainment Index<sup>a</sup> at the SWP and CVP Salvage Facilities—**  
 2 **Differences (Absolute and Percentage) between Model Scenarios for Alternative 3**

Life Stage	Water Year Types	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Juvenile (March–June)	Wet	56,797 (89%)	51,355 (74%)
	Above Normal	5,808 (128%)	5,519 (115%)
	Below Normal	2,311 (75%)	2,103 (64%)
	Dry	186,501 (35%)	128,194 (22%)
	Critical	-127,067 (-22%)	-53,197 (-11%)
	All Years	202,565 (76%)	177,554 (61%)
Adult (Dec–March)	Wet	-38 (-30%)	-42 (-31%)
	Above Normal	-85 (-13%)	-125 (-18%)
	Below Normal	-143 (-7%)	-66 (-4%)
	Dry	-170 (-14%)	-105 (-9%)
	Critical	-6,958 (-29%)	-4,824 (-22%)
	All Years	-1,059 (-29%)	-1,024 (-29%)

Shading indicates >5% increase in entrainment index.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data.

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 The proposed north Delta intakes could increase entrainment potential and locally attract  
 6 piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north Delta  
 7 would be extremely low because this species is not expected to occur this far upstream.

8 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

9 Particle entrainment at the NBA, representing potential larval longfin smelt entrainment, was low  
 10 for both starting distributions (wetter and drier), averaged 0.13-0.16% under Alternative 3, which  
 11 was 0.05% less than NAA, or 47-56% lower in relative terms (Table 11-3-6).

12 **Table 11-3-6. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt**  
 13 **Entrained by the North Bay Aqueduct under Alternative 3 and Baseline Scenarios**

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A3_LLT	A3_LLT vs. EXISTING CONDITIONS	A3_LLT vs. NAA
Wetter	0.20	0.08	0.13	-0.08 (-38.4%)	0.05 (56.1%)
Drier	0.25	0.11	0.16	-0.09 (-36.7%)	0.05 (47.1%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

14

15 In summation, at the SWP/CVP south Delta facilities juvenile longfin smelt entrainment would  
 16 increase substantially under Alternative 3 compared to NAA. Adult entrainment at the south Delta  
 17 facilities would be reduced, especially in critical water year types when longfin smelt distribution

1 extends further into the Delta. Longfin smelt entrainment to the NBA would increase negligibly  
2 compared to NAA. Entrainment loss of longfin smelt at the proposed north Delta intakes would be  
3 low since longfin smelt would occur only rarely in that area of the Sacramento River.

#### 4 ***Predation Associated with Entrainment***

5 Under Alternative 3, pre-screen loss of juvenile longfin smelt at the south Delta facilities, typically  
6 attributed to predation (as described for Impact AQUA-3 for Alternative 1), is expected to increase  
7 for juveniles and decrease for adults commensurate with entrainment. Predation loss at the  
8 proposed north Delta intakes and the alternate NBA intake would be limited because longfin smelt  
9 only rarely occur that far upstream.

10 ***NEPA Effects:*** Overall, the effect of water operations on entrainment and entrainment-related  
11 predation loss of longfin smelt under Alternative 3 would be adverse, particularly because of the  
12 substantial increase in south Delta entrainment and predation loss of juvenile longfin smelt.

13 ***CEQA Conclusion:*** The results of the PTM model indicate slightly lower larval entrainment at the  
14 south Delta facilities, agricultural diversions, and the NBA for all distributions (wetter and drier)  
15 compared to Existing Conditions. At the south Delta facilities, juvenile entrainment would increase  
16 76% while adult entrainment would be reduced 29% compared to Existing Conditions. Entrainment  
17 to the north Delta intakes would be low since longfin smelt would not occur in the vicinity of the  
18 intakes.

19 Predation loss of juveniles would be increased 76% compared to Existing Conditions (based on  
20 salvage data) while predation loss of adults would be reduced by 29%. Predation risk at the  
21 SWP/CVP north Delta intakes would be low because longfin smelt rarely occur in that vicinity.

22 Under Alternative 3, the impact of water operations on longfin smelt would be significant because  
23 the increase in entrainment and predation loss for juveniles would be much greater than the  
24 reduction predicted for adult longfin smelt. As a result, this impact is significant and unavoidable.  
25 Even so, proposed below is mitigation that has the potential to reduce the severity of impact though  
26 not necessarily to a less-than-significant level.

#### 27 **Mitigation Measure AQUA-21a: Following Initial Operations of CM1, Conduct Additional** 28 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of** 29 **Mitigation to Reduce Entrainment Impacts**

30 Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
31 significant and unavoidable adverse effects on entrainment of longfin smelt, this conclusion was  
32 based on the best available scientific information at the time and may prove to have been  
33 overstated. Upon the commencement of operations of CM1 and continuing through the life of the  
34 permit, the BDCP proponents will monitor effects on entrainment in order to determine  
35 whether such effects would be as extensive as concluded at the time of preparation of this  
36 document and to determine any potentially feasible means of reducing the severity of such  
37 effects. This mitigation measure requires a series of actions to accomplish these purposes,  
38 consistent with the operational framework for Alternative 3.

39 The development and implementation of any mitigation actions shall be focused on those  
40 incremental effects attributable to implementation of Alternative 3 operations only.  
41 Development of mitigation actions for the incremental impacts on entrainment attributable to

1 climate change/sea level rise, are not required because these changed conditions would occur  
2 with or without implementation of Alternative 3.

3 **Mitigation Measure AQUA-21b: Conduct Additional Evaluation and Modeling of Impacts**  
4 **on Longfin Smelt Entrainment Following Initial Operations of CM1**

5 Following commencement of initial operations of CM1 and continuing through the life of the  
6 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
7 modified operations could reduce impacts to entrainment under Alternative 3. The analysis  
8 required under this measure may be conducted as a part of the Adaptive Management and  
9 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

10 **Mitigation Measure AQUA-21c: Consult with USFWS and CDFW to Identify and Implement**  
11 **Potentially Feasible Means to Minimize Effects on Longfin Smelt Entrainment Consistent**  
12 **with CM1**

13 In order to determine the feasibility of reducing the effects of CM1 operations on longfin smelt,  
14 the BDCP proponents will consult with USFWS and CDFW to identify and implement any feasible  
15 operational means to minimize effects on entrainment Any such action will be developed in  
16 conjunction with the ongoing monitoring and evaluation of habitat conditions required by  
17 Mitigation Measure AQUA-21a.

18 If feasible means are identified to reduce impacts on entrainment consistent with the overall  
19 operational framework of Alternative 3 without causing new significant adverse impacts on  
20 other covered species, such means shall be implemented. If sufficient operational flexibility to  
21 reduce effects on longfin smelt habitat is not feasible under Alternative 3 operations, achieving  
22 further impact reduction pursuant to this mitigation measure would not be feasible under this  
23 Alternative, and the impact on longfin smelt would remain significant and unavoidable.

24 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**  
25 **Habitat for Longfin Smelt**

26 **NEPA Effects:** Predicted average longfin smelt relative abundance would be reduced under  
27 Alternative 3, resulting in 7% less (based on Fall Midwater Trawl estimates) to 8% less (based on  
28 Bay Otter Trawl estimates) compared to NAA (Table 11-3-7). Under Alternative 3 longfin smelt  
29 relative abundance would be reduced 14–17% in above normal water year types, and reduced 13–  
30 15% in below normal water year types compared to NAA.

1 **Table 11-3-7. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the**  
2 **Fall Midwater Trawl or Bay Otter Trawl**

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A3_LL	NAA vs. A3_LL	EXISTING CONDITIONS vs. A3_LL	NAA vs. A3_LL
All	-1,724 (-33%)	-247 (-7%)	-5,518 (-39%)	-763 (-8%)
Wet	-6,441 (-35%)	-77 (-1%)	-26,449 (-41%)	-300 (-1%)
Above Normal	-3,650 (-43%)	-817 (-14%)	-12,781 (-49%)	-2,736 (-17%)
Below Normal	-1,685 (-39%)	-386 (-13%)	-5,154 (-45%)	-1,134 (-15%)
Dry	-601 (-28%)	-108 (-7%)	-1,621 (-33%)	-284 (-8%)
Critical	-169 (-18%)	-34 (-4%)	-393 (-21%)	-79 (-5%)

Shading indicates 10% or greater decrease in relative abundance.

Note: Based on the X2-Relative Abundance Regressions of Kimmerer et al. (2009).

3

4 The differences in predicted abundance described above result from differences in predicted Delta  
5 outflow in January through June between Alternative 3 and NAA. Averaged across all water years,  
6 predicted Delta outflow under Alternative 3 showed <10% difference relative to NAA during the  
7 peak larval longfin smelt transport period from January-March. During April-June however, Delta  
8 outflows would be reduced 15–25% compared to NAA. The largest differences would occur in above  
9 and below normal water years in April (23–25% reduction in outflow) and in wet, above normal,  
10 and below normal water years in May (25–31% reduction in outflow).

11 Longfin smelt may benefit from habitat restoration which includes *CM2 Yolo Bypass Fisheries*  
12 *Enhancement* for smelt present in Cache Slough region, and *CM4 Tidal Natural Communities*  
13 *Restoration* for smelt in the west Delta and Suisun Bay. This restored habitat is intended to provide  
14 additional food production and export to rearing areas, which may provide benefits to longfin smelt,  
15 particularly from Suisun Marsh, West Delta, and Cache Slough ROAs.

16 **CEQA Conclusion:** Under Alternative 3, average Delta outflows would be increased 7% in January  
17 and February, similar to Existing Conditions in March, and reduced in spring (15-16% decrease in  
18 April and June, 25% decrease in May) compared to Existing Conditions.

19 Average relative longfin smelt abundance, based on Kimmerer et al.2009, decreased 33–39%  
20 compared to Existing Conditions (Table 11-3-7). Relative longfin smelt abundances decreased under  
21 Alternative 3 in all water year types, with the largest reduction (35–49% decrease) in wet, above  
22 normal, and below normal water year types, based on Bay Otter Trawl indices.

23 It is worth noting that this CEQA analysis predicts a greater decrease in juvenile relative abundance  
24 than estimated under the NEPA analysis set forth above. This interpretation of the biological  
25 modeling is likely attributable to different modeling assumptions for four factors: sea level rise,  
26 climate change, future water demands, and implementation of the alternative. As discussed above  
27 (Section 11.3.3), because of differences between the CEQA and NEPA baselines, it is sometimes  
28 possible for CEQA and NEPA significance conclusions to vary between one another under the same  
29 impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was  
30 prepared. Both the action alternative and the NEPA baseline (NAA) models anticipated future  
31 conditions that would occur in 2060 (LLT implementation period), including the projected effects of  
32 climate change (precipitation patterns), sea level rise and future water demands, as well as

1 implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because  
2 the action alternative modeling does not partition the effects of implementation of the alternative  
3 from the effects of sea level rise, climate change and future water demands, the comparison to  
4 Existing Conditions may not offer a clear understanding of the impact of the alternative on the  
5 environment. This suggests that the NEPA analysis, which compares results between the alternative  
6 and NAA, is a better approach because it isolates the effect of the alternative from those of sea level  
7 rise, climate change, and future water demands.

8 When compared to NAA and informed by the NEPA analysis, above, the average longfin smelt  
9 abundance, based on Kimmerer et al. (2009), under Alternative 3 decreased 7–8% compared to NAA  
10 (Table 11-3-7), with the greatest reduction (13-17%) in above normal and below normal water year  
11 types. These results represent the increment of change attributable to the alternative, and address  
12 the limitations of the comparison the CEQA baseline (Existing Conditions).

13 Overall, Alternative 3 could have a significant impact because reduced Delta outflows in the spring  
14 would have the potential to contribute to reductions in longfin smelt abundances. As a result, this  
15 impact is considered significant, and mitigation would be required. Implementation of Mitigation  
16 Measures AQUA-22a through 22c, habitat restoration and adaptive management would reduce this  
17 impact to less than significant.

18 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**  
19 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**  
20 **Mitigation to Reduce Impacts to Rearing Habitat**

21 Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
22 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
23 best available scientific information at the time and may prove to have been overstated. Upon  
24 the commencement of operations of CM1 and continuing through the life of the permit, the  
25 BDCP proponents will monitor effects on rearing habitat in order to determine whether such  
26 effects would be as extensive as concluded at the time of preparation of this document and to  
27 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
28 measure requires a series of actions to accomplish these purposes, consistent with the  
29 operational framework for Alternative 3.

30 The development and implementation of any mitigation actions shall be focused on those  
31 incremental effects attributable to implementation of Alternative 3 operations only.  
32 Development of mitigation actions for the incremental impact on rearing habitat attributable to  
33 climate change/sea level rise are not required because these changed conditions would occur  
34 with or without implementation of Alternative 3.

35 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**  
36 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

37 Following commencement of initial operations of CM1 and continuing through the life of the  
38 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
39 modified operations could reduce impacts to rearing habitat under Alternative 3. The analysis  
40 required under this measure may be conducted as a part of the Adaptive Management and  
41 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

1           **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**  
2           **Potentially Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat**  
3           **Consistent with CM1**

4           In order to determine the feasibility of reducing the effects of CM1 operations on longfin smelt  
5           habitat, the BDCP proponents will consult with NMFS, USFWS and CDFW to identify and  
6           implement any feasible operational means to minimize effects on rearing habitat. Any such  
7           action will be developed in conjunction with the ongoing monitoring and evaluation of habitat  
8           conditions required by Mitigation Measure AQUA-22a.

9           If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
10          operational framework of Alternative 3 without causing new significant adverse impacts on  
11          other covered species, such means shall be implemented. If sufficient operational flexibility to  
12          reduce effects on longfin smelt habitat is not feasible under Alternative 3 operations, achieving  
13          further impact reduction pursuant to this mitigation measure would not be feasible under  
14          Alternative 3, and the impact on longfin smelt would remain significant and unavoidable.

15          **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

16          The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on rearing habitat  
17          for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on Spawning, Egg  
18          Incubation, and Rearing Habitat for Longfin Smelt.

19          **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

20          The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on migration  
21          conditions for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on  
22          Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.

23          **Restoration Measures (CM2, CM4–CM7, and CM10)**

24          Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
25          differences in restoration-related effects on fish are anticipated anywhere in the affected  
26          environment under Alternative 3 compared to those described in detail for Alternative 1A, the  
27          effects of restoration measures on longfin smelt described under Alternative 1A (Impact AQUA-25  
28          through AQUA-27) also appropriately characterize effects under Alternative 3.

29          The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

30          **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

31          **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**  
32          **Smelt**

33          **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

34          **NEPA Effects:** All of these effects have been determined to result in no adverse effects on longfin  
35          smelt. Specifically for AQUA-26, the effects of contaminants on longfin smelt with respect to  
36          selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on  
37          longfin smelt are uncertain.

1 **CEQA Conclusions:** The overall effects of the restoration measures is considered less than significant  
2 for CEQA purposes for the reasons identified for Alternative 1A.

3 **Other Conservation Measures (CM12–CM19 and CM21)**

4 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
5 differences in other conservation-related effects on fish are anticipated anywhere in the affected  
6 environment under Alternative 3 compared to those described in detail for Alternative 1A, the  
7 effects of other conservation measures on longfin smelt described under Alternative 1A (Impact  
8 AQUA-28 through AQUA-36) also appropriately characterize effects under Alternative 3.

9 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

10 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

11 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
12 **(CM13)**

13 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

14 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

15 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

16 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

17 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

18 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

19 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
20 **(CM21)**

21 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
22 adverse effect, or beneficial effects on longfin smelt, for the reasons identified for Alternative 1A.

23 **CEQA Conclusions:** The nine impact mechanisms would be considered to range from no impact, to  
24 less than significant, or beneficial on longfin smelt, for the reasons identified for Alternative 1A, and  
25 no mitigation is required.

26 **Winter-Run Chinook Salmon**

27 **Construction and Maintenance of CM1**

28 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
29 **(Winter-Run ESU)**

30 The potential effects of construction of water conveyance facilities on Chinook salmon under  
31 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-37) except  
32 that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the  
33 effects would be proportionally less under this alternative. This would convert about 4,450 lineal

1 feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of  
2 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
3 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
4 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
5 contaminated sediments would be similar to Alternative 1A and the same environmental  
6 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
7 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
8 effects.

9 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-37, environmental commitments and  
10 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
11 not be adverse for Chinook salmon.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-37, the impact of the construction of  
13 water conveyance facilities on Chinook salmon would be less than significant except for  
14 construction noise associated with pile driving which would only occur for two intakes rather than  
15 five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would  
16 reduce that noise impact to less than significant.

17 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
18 **of Pile Driving and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
20 Alternative 1A.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
22 **and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
24 Alternative 1A.

25 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
26 **(Winter-Run ESU)**

27 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
28 Alternative 3 would be the similar to those described for Alternative 1A except that only two intakes  
29 would need to be maintained under Alternative 3 instead of five under Alternative 1A (see Impact  
30 AQUA-2, delta smelt). As concluded in Alternative 1A, Impact AQUA-38, the effect would not be  
31 adverse for Chinook salmon.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance  
33 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation  
34 would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**  
3 **Run ESU)**

4 ***Water Exports from SWP/CVP South Delta Facilities***

5 Alternative 3 would reduce the overall entrainment of juvenile winter-run Chinook salmon at the  
6 south Delta export facilities. Average entrainment would decrease 22% across all water year types  
7 compared to NAA (Table 11-3-8), with the greatest reductions in wetter years (18% to 33% less  
8 compared to NAA). Pre-screen losses, typically attributed to predation, would be expected to  
9 decrease commensurate with decreased entrainment at the south Delta facilities.

10 **Table 11-3-8. Juvenile Chinook Salmon Annual Entrainment Index<sup>a</sup> at the SWP and CVP Salvage**  
11 **Facilities—Differences between Model Scenarios for Alternative 3**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
<b>Winter-Run Chinook Salmon</b>		
Wet	-3,467 (-30%)	-3,888 (-33%)
Above Normal	-1,582 (-24%)	-1,707 (-25%)
Below Normal	-1,626 (-23%)	-1,202 (-18%)
Dry	-337 (-9%)	-30 (-1%)
Critical	-195 (-15%)	-56 (-5%)
All Years	-1,546 (-23%)	-1,486 (-22%)

Shading indicates entrainment increased 5% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data.

12  
13 ***Water Exports from SWP/CVP North Delta Intake Facilities***

14 As described under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids  
15 at the north Delta intakes would be greater than baseline, but the effects would be minimal because  
16 the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

17 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

18 As described under Alternative 1A (Impact AQUA-39), potential entrainment and impingement  
19 effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens  
20 installed.

21 ***NEPA Effects:*** In conclusion, Alternative 3 would reduce the overall entrainment of juvenile winter  
22 Chinook salmon compared to baseline conditions, which would be a beneficial impact.

23 ***CEQA Conclusion:*** As discussed above, entrainment losses of juvenile winter-run Chinook salmon at  
24 the south Delta export facilities would decrease under Alternative 3 compared to Existing  
25 Conditions (Table 11-3-8). Impacts at the north Delta intake facilities would be similar to Alternative  
26 1A but less because Alternative 3 has only two intakes. Overall, impacts would be less than  
27 significant and may be beneficial due to reductions in entrainment at the south Delta export facilities  
28 and at the north Delta intake facilities. No mitigation would be required.

1 The impact and conclusion for predation associated with entrainment is the same as described  
2 above, because although combined predation losses at the south Delta and the proposed north Delta  
3 intakes would increase for all races of juveniles, there would not be substantial effects on population  
4 levels. The impacts would be less than significant, no mitigation would be required.

5 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
6 **Chinook Salmon (Winter-Run ESU)**

7 In general, effects of Alternative 3 on spawning and egg incubation habitat for winter-run Chinook  
8 salmon relative to NAA are uncertain.

9 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were  
10 examined during the May through September winter-run Chinook salmon spawning period  
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the  
12 instream area available for spawning and egg incubation. Flows under A3\_LLT during May through  
13 July would generally be similar to or greater than flows under NAA except in dry years during July  
14 (9% at both locations). Flows during August and September under A3\_LLT would be mostly lower  
15 than flows under NAA (up to 45% lower depending on month, location, and water year type).

16 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the  
17 May through September winter-run spawning and egg incubation period. May Shasta storage  
18 volume under A3\_LLT would be similar to or greater than storage under NAA for all water year  
19 types except below normal (8% lower) and dry (6% lower) (Table 11-3-9).

20 These results indicate that there would be small to moderate effects of Alternative 3 relative to NAA.

21 **Table 11-3-9. Difference and Percent Difference in May Water Storage Volume (thousand acre-**  
22 **feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-78 (-2%)	-44 (-1%)
Above Normal	-161 (-4%)	-75 (-2%)
Below Normal	-518 (-13%)	-320 (-8%)
Dry	-634 (-17%)	-190 (-6%)
Critical	-593 (-24%)	-9 (0%)

23

24 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
25 Alternative 1A, Impact AQUA-40, which indicates that there would generally be no effects on water  
26 temperature in the Sacramento River.

27 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
28 Sacramento River under A3\_LLT would be similar to mortality under NAA in wet and critical years  
29 (<5% difference). Egg mortality under A3\_LLT would be 12% to 97% greater than mortality under  
30 NAA in above normal, below normal, and dry water years, although these increases represent a 0.3  
31 to 2% absolute scale change in the winter-run Chinook salmon population (Table 11-3-10).

32 Therefore, this effect is considered negligible to the winter-run population. These results indicate  
33 that climate change would cause the majority of the increase in winter-run egg mortality.

1 **Table 11-3-10. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook**  
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	1 (270%)	-0.03 (-2%)
Above Normal	2 (413%)	0.3 (13%)
Below Normal	3 (267%)	2 (97%)
Dry	7 (440%)	1 (12%)
Critical	43 (159%)	-1 (-2%)
All	9 (190%)	0.3 (2%)

3  
4 SacEFT predicts that there would be a 22% decrease in the percentage of years with good spawning  
5 availability, measured as weighted usable area, under A3\_LLT relative to NAA (Table 11-3-11). This  
6 reduction would be 7% on an absolute scale and, therefore, is considered a small effect. SacEFT  
7 predicts that the percentage of years with good (lower) redd scour risk under A3\_LLT would be  
8 identical to the percentage of years under NAA. SacEFT predicts that the percentage of years with  
9 good egg incubation conditions under A3\_LLT would be similar to (<5% difference) that under NAA.  
10 SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A3\_LLT  
11 would be 10% lower than risk under NAA, which is negligible (3%) on an absolute scale.

12 The biological significance of a reduction in available suitable spawning habitat varies at the  
13 population level in response to a number of factors, including adult escapement. For those years  
14 when adult escapement is less than the carrying capacity of the spawning habitat, a reduction in  
15 area would have little or no population level effect. In years when escapement exceeds carrying  
16 capacity of the reduced habitat, competition among spawners for space (e.g., increased redd  
17 superimposition) would increase, resulting in reduced reproductive success. The reduction in the  
18 frequency of years in which spawning habitat availability is considered to be good by SacEFT could  
19 result in reduced reproductive success and abundance of winter-run Chinook salmon if the number  
20 of spawners is limited by spawning habitat quantity

21 **Table 11-3-11. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
22 **for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Spawning WUA	-33 (-57%)	-7 (-22%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-25 (-26%)	-2 (-3%)
Redd Dewatering Risk	1 (4%)	-3 (-10%)
Juvenile Rearing WUA	-10 (-20%)	15 (60%)
Juvenile Stranding Risk	-14 (-70%)	-25 (-81%)

WUA = Weighted Usable Area.

23  
24 **NEPA Effects:** Available analytical tools show conflicting results regarding the temperature effects of  
25 relatively small changes in predicted summer and fall flows. Several models (CALSIM, SRWQM, and  
26 Reclamation Egg Mortality Model) generally show no change in upstream conditions as a result of  
27 Alternative 3. However, one model, SacEFT, shows adverse effects under some conditions. After

1 extensive investigation of these results, they appear to be a function of high model sensitivity to  
2 relatively small changes in estimated upstream conditions, which may or may not accurately predict  
3 adverse effects. The new NDD structures allow for spring time deliveries of water south of the Delta  
4 that are currently constrained under the NAA. For this reason, additional spring storage criteria may  
5 be necessary to ensure Shasta Reservoir operations similar to what was modeled. These discussions  
6 will occur in the Section 7 consultation with Reclamation on Shasta Reservoir and system-wide  
7 operations, which is outside the scope of BDCP. In conclusion, Alternative 3 modeling results  
8 support a finding that effects are uncertain, but modeled results are mixed and operations that  
9 match the CALSIM modeling are not assured. Model results will be submitted to independent peer  
10 review to confirm that adverse effects are not reasonably anticipated to occur.

11 **CEQA Conclusion:** In general, Alternative 3 would not affect spawning and egg incubation habitat for  
12 winter-run Chinook salmon relative to the Existing Conditions.

13 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined  
14 during the May through September winter-run spawning and egg incubation period (Appendix 11C,  
15 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT during May through July  
16 would generally be similar to or greater than flows under Existing Conditions, except in wet years  
17 during May (14% to 18% lower depending on location) and in dry and critical years during July (6%  
18 to 11% lower depending on month and location) and August (21% to 25% lower depending on  
19 location). Flows under A3\_LLT during August and September would generally be lower than flows  
20 under Existing Conditions by up to 27% depending on month, water year type, and location.

21 Shasta Reservoir storage volume at the end of May under A3\_LLT would be similar to Existing  
22 Conditions in wet and above normal water years, but lower by 13% to 24% in below normal, dry,  
23 and critical water years (Table 11-3-9). This indicates that there would be a small to moderate effect  
24 of Alternative 3 on flows during the spawning and egg incubation period.

25 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
26 Alternative 1A, Impact AQUA-40, which indicates that there would be increased exceedances of  
27 NMFS temperature thresholds in the Sacramento River relative to Existing Conditions.

28 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
29 Sacramento River under A3\_LLT would be 159% to 440% greater than mortality under Existing  
30 Conditions depending on water year type (Table 11-3-10). These increases would only affect the  
31 winter-run population during dry and critical years, in which the absolute percent increase of the  
32 winter-run population would be 7% and 43%, respectively. These results indicate that Alternative 3  
33 would cause substantially increased winter-run Chinook salmon mortality in drier years in the  
34 Sacramento River.

35 SacEFT predicts that there would be a 57% decrease in the percentage of years with good spawning  
36 availability, measured as weighted usable area, under A3\_LLT relative to Existing Conditions (Table  
37 11-3-11). SacEFT predicts that the percentage of years with good (lower) redd scour risk under  
38 A3\_LLT would be identical to the percentage of years under Existing Conditions. SacEFT predicts  
39 that the percentage of years with good egg incubation conditions under A3\_LLT would be 26%  
40 lower than under Existing Conditions. SacEFT predicts that the percentage of years with good  
41 (lower) redd dewatering risk under A3\_LLT would be similar (<5% difference) to the percentage of  
42 years under Existing Conditions. These results indicate that Alternative 3 would cause moderate to  
43 substantial reductions in spawning WUA and egg incubation conditions.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between  
3 the CEQA baseline and Alternative 3 could be significant because, when compared to the CEQA  
4 baseline, the alternative could substantially reduce suitable spawning habitat and substantially  
5 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth  
6 above. Flows and water temperature conditions would be degraded in the Sacramento River under  
7 Alternative 3 relative to Existing Conditions. Egg mortality in drier years, during which winter-run  
8 Chinook salmon would already be stressed due to reduced flows and increased temperatures, would  
9 be up to 43% greater (on an absolute scale) due to Alternative 3 compared to the Existing  
10 Conditions (Table 11-3-10). Further, the extent of spawning habitat would be 33% lower (absolute  
11 scale) and egg incubation would be reduced by 25% (absolute scale) under Alternative 3 compared  
12 to the Existing Conditions (Table 11-3-11), which represent a substantial reductions spawning and  
13 egg incubation conditions for winter-run Chinook salmon.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
15 change, future water demands, and implementation of the alternative. The analysis described above  
16 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
17 alternative from those of sea level rise, climate change and future water demands using the model  
18 simulation results presented in this chapter. However, the increment of change attributable to the  
19 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
20 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
21 implementation period, which does include future sea level rise, climate change, and water  
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow and reservoir storage outputs between Existing  
26 Conditions in the late long-term implementation period and Alternative 3 indicates that flows and  
27 reservoir storage in the locations and during the months analyzed above would generally be similar  
28 between future conditions without the alternative (NAA) and Alternative 3. This indicates that the  
29 differences between Existing Conditions and Alternative 3 found above would generally be due to  
30 climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA  
31 conclusion regarding Alternative 3, if adjusted to exclude sea level rise and climate change, is similar  
32 to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning  
33 habitat for winter-run Chinook salmon. This impact is found to be less than significant and no  
34 mitigation is required.

35 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
36 **(Winter-Run ESU)**

37 In general, Alternative 3 would reduce the quality of rearing habitat for fry and juvenile winter-run  
38 Chinook salmon relative to NAA.

39 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
40 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
41 *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing  
42 habitat. Flows under A3\_LLTT would generally be similar to or greater than flows under NAA during  
43 October and December, but up to 43% lower than flows under NAA during August, September, and  
44 November depending on month and water year type. This indicates that both climate change and

1 Alternative 3 would cause small to moderate reductions in flows in the Sacramento River during  
2 most months of the winter-run upstream fry and juvenile rearing period.

3 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
4 Alternative 1A, Impact AQUA-41, which indicates that there would be no effect on mean monthly  
5 temperatures during the winter-run juvenile rearing period.

6 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
7 measured as weighted usable area, under A3\_LLT would be 60% greater (15% higher on an absolute  
8 scale) than that under NAA (Table 11-3-10). In addition, the percentage of years with good (low)  
9 juvenile stranding risk under A3\_LLT is predicted to be 81% lower (25% lower on an absolute scale)  
10 than that under NAA. This indicates that, although the quantity of juvenile rearing habitat in the  
11 Sacramento River under Alternative 3 would be substantially similar to or higher than NAA, the  
12 quality of this habitat, measured as stranding risk, would be substantially lower.

13 SALMOD predicts that mean winter-run smolt equivalent habitat-related mortality under A3\_LLT  
14 would be similar (<5% difference) to mortality under NAA.

15 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the  
16 potential to substantially reduce the amount of suitable rearing habitat. Under Alternative 3, there  
17 would be large flow reductions during 3 months of the 5-month the larval and juvenile rearing  
18 period. Also, stranding risk of larvae and juveniles would be substantially higher under Alternative  
19 3 relative to NAA (Table 11-3-11). This effect is a result of the specific reservoir operations and  
20 resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir  
21 operations in order to alter the flows) to the extent necessary to reduce this effect to a level that is  
22 not adverse would fundamentally change the alternative, thereby making it a different alternative  
23 than that which has been modeled and analyzed. As a result, this would be an unavoidable adverse  
24 effect. Even so, proposed mitigation (Mitigation Measure AQUA-41a through AQUA-41c) has the  
25 potential to reduce the severity of impact, although not necessarily to a not adverse level.

26 **CEQA Conclusion:** In general, Alternative 3 would reduce the quantity and quality of fry and juvenile  
27 rearing habitat for winter-run Chinook salmon relative to the Existing Conditions.

28 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
29 salmon rearing period (August through December) (Appendix 11C, CALSIM II Model Results utilized  
30 in the Fish Analysis). During September, October, and December, flows under A3\_LLT would  
31 generally be similar to or greater than flows under Existing Conditions, except in wet and dry water  
32 years during September (23% and 20% lower, respectively). During August and November, flow  
33 would be nearly always lower than under Existing Conditions by up to 24% depending on month  
34 and water year type.

35 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
36 Alternative 1A, Impact AQUA-41, which indicates that there would be small temperature increases  
37 under Alternative 1A during some months in the Sacramento River.

38 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
39 measured as weighted usable area, under A3\_LLT would be 20% lower than under Existing  
40 Conditions (Table 11-3-11). In addition, the percentage of years with good (low) juvenile stranding  
41 risk under A3\_LLT is predicted to be 70% lower than under Existing Conditions. These results  
42 indicate that there would be a small reduction in the amount of juvenile rearing habitat and a

1 moderate reduction in the quality of juvenile rearing habitat in the Sacramento River, measured as  
2 stranding risk, under Alternative 3 relative to Existing Conditions.

3 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A3\_LLT would  
4 be 9% higher than under Existing Conditions.

#### 5 **Summary of CEQA Conclusion**

6 These results indicate that the impact would be significant because it has the potential to  
7 substantially reduce the amount of suitable habitat and substantially interfere with the movement of  
8 fish. Differences in flows are moderately large during August and November. Temperatures would  
9 increase in the Sacramento River during the winter-run rearing period under Alternative 3. Further,  
10 a 20% reduction (10% on an absolute scale) in rearing habitat quantity and 70% increase (14% on  
11 an absolute scale) in stranding risk would reduce upstream habitat conditions for winter-run fry  
12 and juveniles. SALMOD predicts that habitat-related mortality will increase due to Alternative 3.  
13 This impact is a result of the specific reservoir operations and resulting flows associated with this  
14 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
15 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
16 change the alternative, thereby making it a different alternative than that which has been modeled  
17 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
18 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
19 severity of impact though not necessarily to a less-than-significant level.

#### 20 **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional** 21 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine** 22 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

23 Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
24 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
25 best available scientific information at the time and may prove to have been overstated. Upon  
26 the commencement of operations of CM1 and continuing through the life of the permit, the  
27 BDCP proponents will monitor effects on rearing habitat in order to determine whether such  
28 effects would be as extensive as concluded at the time of preparation of this document and to  
29 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
30 measure requires a series of actions to accomplish these purposes, consistent with the  
31 operational framework for Alternative 3.

32 The development and implementation of any mitigation actions shall be focused on those  
33 incremental effects attributable to implementation of Alternative 3 operations only.  
34 Development of mitigation actions for the incremental impact on spawning habitat attributable  
35 to climate change/sea level rise are not required because these changed conditions would occur  
36 with or without implementation of Alternative 3.

#### 37 **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts** 38 **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

39 Following commencement of initial operations of CM1 and continuing through the life of the  
40 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
41 modified operations could reduce impacts to rearing habitat under Alternative 3. The analysis

1 required under this measure may be conducted as a part of the Adaptive Management and  
2 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

3 **Mitigation Measure AQUA-41c: Consult with NMFS, USFWS, and CDFW to Identify and**  
4 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**  
5 **Salmon Rearing Habitat Consistent with CM1**

6 In order to determine the feasibility of reducing the effects of CM1 operations on Chinook  
7 salmon habitat, the BDCP proponents will consult with NMFS, USFWS, and CDFW to identify and  
8 implement any feasible operational means to minimize effects on rearing habitat. Any such  
9 action will be developed in conjunction with the ongoing monitoring and evaluation of habitat  
10 conditions required by Mitigation Measure AQUA-41a.

11 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
12 operational framework of Alternative 3 without causing new significant adverse impacts on  
13 other covered species, such means shall be implemented. If sufficient operational flexibility to  
14 reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 3  
15 operations, achieving further impact reduction pursuant to this mitigation measure would not  
16 be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain  
17 significant and unavoidable.

18 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
19 **(Winter-Run ESU)**

20 In general, Alternative 3 would reduce migration conditions for winter-run Chinook salmon relative  
21 to NAA.

22 **Upstream of the Delta**

23 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November  
24 juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run  
25 Chinook salmon to migrate effectively down the Sacramento River. Flows under A3\_LLT would  
26 generally be similar to flows under NAA during July, up to 43% lower under NAA during July,  
27 August, and November, and up to 33% greater during October (*Appendix 11C, CALSIM II Model*  
28 *Results utilized in the Fish Analysis*). This indicates that Alternative 3 would cause small to moderate  
29 reductions in flows in the Sacramento River during the majority of months during the winter-run  
30 migration period.

31 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run  
32 Chinook salmon upstream migration period (December through August). A reduction in flows may  
33 reduce the olfactory cues needed by adult winter-run Chinook salmon to return to natal spawning  
34 grounds in the upper Sacramento River. Flows under A3\_LLT would generally be similar to flows  
35 under NAA, except during May, in which flows would be up to 15% greater, and during August, in  
36 which flows would be up to 43% lower.

37 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
38 Alternative 1A, Impact AQUA-42, which indicates there would be no differences in water  
39 temperatures between NAA and Alternative 1A.

1 **Through-Delta**

2 The effects on through-Delta migration were evaluated using the approach described in Alternative  
3 1A, Impact AQUA-42.

4 **Juveniles**

5 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows  
6 below the north Delta intakes by up to 26% averaged over all water year types compared to baseline  
7 conditions. The two intake structures of Alternative 3 would replace aquatic habitat and likely  
8 attract piscivorous fish around the intake structures, as described above in Impact AQUA-42. The  
9 two intakes would remove or modify habitat along that portion of the migration corridor (8.3 acres  
10 aquatic habitat and 4,450 linear feet of shoreline). Potential predation losses at the north Delta  
11 intakes, as estimated by the bioenergetics model for two intakes with median density of predators  
12 (119 striped bass per 1,000 feet of intake), would be 0.7% of the annual juvenile production  
13 estimated for the Sacramento Valley (Table 11-3-12). A conservative assumption of 5% loss per  
14 intake would yield a cumulative loss of 8% of juvenile winter-run Chinook that reach the north  
15 Delta. This assumption is uncertain and represents an upper bound estimate.

16 **Table 11-3-12. Chinook Salmon Predation Loss at the Proposed North Delta Diversion Intakes for**  
17 **Alternative 3 (Two Intakes)**

Striped Bass Numbers		Estimated Number of Juvenile Salmon Consumed				Percentage of Annual Juvenile Production (%) Consumed			
Per 1,000 ft. of Intake	Total Bass	Winter	Spring	Fall	Late Fall	Winter	Spring	Fall	Late Fall
18 (Low)	52	2,651	3,709	56,870	10,760	0.10%	0.09%	0.09%	0.25%
119 (Median)	345	17,525	24,520	375,972	71,138	0.67%	0.58%	0.61%	1.65%
219 (High)	635	32,252	45,125	691,916	130,918	1.24%	1.07%	1.12%	3.04%

18  
19 Through-Delta survival by emigrating juvenile winter-run Chinook salmon under Alternative 3  
20 (A3\_LLTT) I would be similar to NAA (Table 11-3-13).

21 **Table 11-3-13. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**  
22 **under Alternative 3**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A3_LLTT	EXISTING CONDITIONS vs. A3_LLTT	NAA vs. A3_LLTT
Wetter Years	46.3	46.1	45.3	-1.0 (-2%)	-0.8 (-2%)
Drier Years	28.0	27.1	26.4	-1.6 (-6%)	-0.7 (-3%)
All Years	34.9	34.2	33.5	-1.4 (-4%)	-0.7 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.  
Wetter = Wet and Above Normal WYs (6 years).  
Drier = Below Normal, Dry and Critical WYs (10 years).

23

**Adults**

Adult salmonids migrating through the Delta use flow and olfactory cues for navigation to their natal streams (Marston et al. 2012). Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville (DSM2 fingerprinting), would decrease less than 10% compared to NAA during the adult winter-run upstream migration from December-July (Table 11-3-14). The reductions in percentage are small in comparison with the magnitude of change in dilution (20%) reported to cause a significant change in migration by Fretwell (1989) and, therefore, are not expected to affect adult Chinook salmon migration. Therefore, it is expected that olfactory cues for adult winter-run Chinook salmon from the Sacramento River would be adequate and not substantially affected by flow operations under Alternative 3. However, uncertainty remains with regard to adult salmon behavioral response to anticipated changes in lower Sacramento River flow percentages. This topic is discussed further in Impact AQUA-42 for Alternative 1A.

**Table 11-3-14. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 3**

Month	EXISTING CONDITIONS	NAA	A3_LL	EXISTING CONDITIONS vs. A3_LL	NAA vs. A3_LL
<b>Sacramento River</b>					
September	60	65	54	-6	-11
October	60	68	66	6	-2
November	60	66	63	3	-3
December	67	66	64	-3	-2
January	76	75	73	-3	-2
February	75	72	69	-6	-3
March	78	76	69	-9	-7
April	77	75	69	-8	-6
May	69	65	63	-6	-2
<b>San Joaquin River</b>					
September	0.3	0.1	0.8	0.5	0.7
October	0.2	0.3	0.9	0.7	0.6
November	0.4	1.0	1.8	1.4	0.8
December	0.9	1.0	1.1	0.2	0.1
January	1.6	1.7	2.2	0.6	0.5
February	1.4	1.5	2.4	1.0	0.9
March	2.6	2.8	4.5	1.9	1.7
April	6.3	6.6	7.3	1.0	0.7
Shading indicates 10% or greater absolute difference.					

**NEPA Effects:** Overall, the results indicate that the effect of Alternative 3 is adverse because it has the potential to substantially decrease winter-run Chinook salmon migration habitat conditions in the Sacramento River.

Upstream of the Delta in the Sacramento River, flows would be up to 43% lower during the majority of the juvenile migration period. These reductions in flow may impact the condition and survival of juvenile winter-run Chinook salmon as they migrate downstream. There would be no differences

1 between Alternative 3 and NAA in upstream flows during the adult migration period or in water  
2 temperatures during both juvenile and adult migration periods.

3 Adult attraction flows in the Delta under Alternative 3 would be lower than those under NAA, but  
4 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

5 Near-field effects of Alternative 3 NDD on winter-run Chinook salmon related to impingement and  
6 predation associated with three new intake structures could result in negative effects on juvenile  
7 migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall  
8 effects. It is expected that the level of near-field impacts would be directly correlated to the number  
9 of new intake structures in the river and thus the level of impacts associated with 2 new intakes  
10 would be considerably lower than those expected from having 5 new intakes in the river. Estimates  
11 within the effects analysis range from very low levels of effects (<1% mortality) to more significant  
12 effects (~ 8% mortality above current baseline levels). CM15 would be implemented with the intent  
13 of providing localized and temporary reductions in predation pressure at the NDD. Additionally,  
14 several pre-construction surveys to better understand how to minimize losses associated with the 2  
15 new intake structures will be implemented as part of the final NDD screen design effort. Alternative  
16 3 also includes an Adaptive Management Program and Real-Time Operational Decision-Making  
17 Process to evaluate and make limited adjustments intended to provide adequate migration  
18 conditions for winter-run Chinook. However, at this time, due to the absence of comparable facilities  
19 anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field  
20 effects at the NDD remains highly uncertain.

21 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
22 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
23 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 3  
24 predict improvements in smolt condition and survival associated with increased access to the Yolo  
25 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
26 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
27 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

28 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
29 all of these elements of BDCP operations and conservation measures to predict smolt migration  
30 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
31 migration survival under Alternative 3 would be similar to those estimated for NAA. Further  
32 refinement and testing of the DPM, along with several ongoing and planned studies related to  
33 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
34 future. These efforts are expected to improve our understanding of the relationships and  
35 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
36 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

37 Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 3 on  
38 winter-run Chinook salmon migration conditions would be adverse.

39 This effect is a result of the specific reservoir operations and resulting flows associated with this  
40 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
41 the extent necessary to reduce this impact to a level that is not adverse would fundamentally change  
42 the alternative, thereby making it a different alternative than that which has been modeled and  
43 analyzed. As a result, this effect is adverse and unavoidable because there is no feasible mitigation  
44 available.

1 **CEQA Conclusion:** In general, Alternative 3 would not affect migration conditions for winter-run  
2 Chinook salmon relative to the Existing Conditions.

### 3 **Upstream of the Delta**

4 Flows in the Sacramento River upstream of Red Bluff were examined during the July through  
5 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Flows under A3\_LL1T for juvenile migrants would generally be greater than or similar to  
7 flows under Existing Conditions during August and November, in which flows would be up to 24%  
8 lower depending on month and water year type.

9 Flows in the Sacramento River upstream of Red Bluff were examined during the December through  
10 August adult migration period. Flows under A3\_LL1T would generally be similar to or greater than  
11 flows under Existing Conditions, except during August in which flows would be up to 24% lower  
12 under A3\_LL1T.

13 Water temperatures in the Sacramento River under Alternative3 would be the same as those under  
14 Alternative 1A, Impact AQUA-42, which indicates that there would be small increase in water  
15 temperatures under Alternative 3 during large portions of the juvenile and adult migration periods,  
16 compared to Existing Conditions.

### 17 **Through-Delta**

18 Through-Delta survival of juvenile winter-run Chinook salmon would be similar compared to  
19 Existing Conditions when averaged across all water years (<4% relative decrease) (Table 11-3-13.  
20 Predation of migrating juveniles would increase at the north Delta intakes, with loss hypothetically  
21 estimated of 0.7% to 8% of juveniles reaching the Delta. Attraction flows and olfactory cues for  
22 migrating adult winter-run Chinook salmon under Alternative 3, as indicated by the proportion of  
23 Sacramento River flows (54–73% of Delta water), would be similar (<10% difference) to Existing  
24 Conditions for (Table 11-3-14).

### 25 **Summary of CEQA Conclusion**

26 Due to the similarity in migration flows and water temperatures between Alternative 3 and the  
27 CEQA baseline for all months except November, upstream habitat and movement conditions are not  
28 substantially reduced for juvenile or adult winter-run Chinook salmon. Through-Delta survival of  
29 juvenile winter-run Chinook salmon would be similar compared to Existing Conditions. Further,  
30 based on the proportion of Sacramento River flows, olfactory cues would be similar (<10%  
31 difference) to Existing Conditions for adult winter-run Chinook salmon migrating through the Delta.  
32 Therefore, the overall impact of Alternative 3 on winter-run Chinook salmon would be less than  
33 significant, and no mitigation would be required.

### 34 **Restoration Measures (CM2, CM4–CM7, and CM10)**

35 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
36 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
37 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
38 restoration measures described for winter-run Chinook salmon under Alternative 1A (Impact  
39 AQUA-43 through AQUA-45) also appropriately characterize effects under Alternative 3.

1 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

2 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
3 **(Winter-Run ESU)**

4 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
5 **Salmon (Winter-Run ESU)**

6 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
7 **ESU)**

8 *NEPA Effects:* All of these effects have been determined to result in no adverse effects on winter-run  
9 Chinook salmon for NEPA purposes. Specifically for AQUA-44, the effects of contaminants on winter-  
10 run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be  
11 adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

12 *CEQA Conclusions:* As described under Alternative 1A, the overall effect of these restoration  
13 measures would be considered less than significant for CEQA purposes for the reasons identified for  
14 Alternative 1A.

15 **Other Conservation Measures (CM12–CM19 and CM21)**

16 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
17 differences in other conservation-related effects on fish are anticipated anywhere in the affected  
18 environment under Alternative 3 compared to those described in detail for Alternative 1A, the  
19 effects of other conservation measures on winter-run Chinook salmon as described under  
20 Alternative 1A (Impact AQUA-46 through AQUA-54) also appropriately characterize effects under  
21 Alternative 3.

22 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

23 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**  
24 **ESU) (CM12)**

25 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
26 **(Winter-Run ESU) (CM13)**

27 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**  
28 **Run ESU) (CM14)**

29 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
30 **(Winter-Run ESU) (CM15)**

31 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**  
32 **(CM16)**

33 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**  
34 **(CM17)**

1 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**  
2 **(CM18)**

3 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**  
4 **ESU) (CM19)**

5 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
6 **(Winter-Run ESU) (CM21)**

7 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no  
8 adverse effect, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the  
9 reasons identified for Alternative 1A.

10 *CEQA Conclusions:* The nine impact mechanisms would be considered to range from no impact, to  
11 less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for  
12 Alternative 1A, and no mitigation is required.

13 **Spring-Run Chinook Salmon**

14 **Construction and Maintenance of CM1**

15 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
16 **(Spring-Run ESU)**

17 The potential effects of construction of water conveyance facilities on spring-run Chinook salmon  
18 under Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-55)  
19 except that Alternative 3 would include two intakes compared to five intakes under Alternative 1A,  
20 so the effects would be proportionally less under this alternative. This would convert about 4,450  
21 lineal feet of existing shoreline habitat into intake facility structures and would require about 10.2  
22 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet  
23 of shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
24 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
25 contaminated sediments would be similar to Alternative 1A and the same environmental  
26 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
27 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
28 effects.

29 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-55, environmental commitments and  
30 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
31 not be adverse for spring-run Chinook salmon.

32 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-55, the impact of the construction of  
33 water conveyance facilities on spring-run Chinook salmon would be less than significant except for  
34 construction noise associated with pile driving. Potential pile driving impacts would be less than  
35 Alternative 1A because only two intakes would be constructed rather than five. Implementation of  
36 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
37 less than significant.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
4           Alternative 1A.

5           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
6           **and Other Construction-Related Underwater Noise**

7           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
8           Alternative 1A.

9           **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
10          **(Spring-Run ESU)**

11          The maintenance-related effects of Alternative 3 would be identical for all four Chinook salmon  
12          ESUs. Accordingly, for a discussion of the impacts, please refer to the discussion for winter-run  
13          Chinook salmon (Alternative 3, Impact AQUA-38).

14          **Water Operations of CM1**

15          **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
16          **ESU)**

17          ***Water Exports from SWP/CVP South Delta Facilities***

18          Alternative 3 would increase overall entrainment of juvenile spring-run Chinook salmon at the south  
19          Delta export facilities, estimated as salvage density, by 45% (Table 11-3-15) across all water years  
20          compared to NAA. Entrainment would be highest in above normal years and lowest in critical years.  
21          Under Alternative 3, entrainment would increase 143% in above normal water years and increase  
22          107% in below normal water years compared to NAA. Pre-screen losses, typically attributed to  
23          predation, would be expected to increase commensurate with increased entrainment at the south  
24          Delta facilities.

25          The average proportion of the annual spring-run Chinook salmon population (assumed to be  
26          750,000 juveniles approaching the Delta) lost at the south Delta facilities would increase about 2%  
27          under Alternative 3 compared to NAA.

1 **Table 11-3-15. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index<sup>a</sup> at the SWP and**  
2 **CVP Salvage Facilities—Differences between Model Scenarios for Alternative 3**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
<b>Spring-Run Chinook Salmon</b>		
Wet	16,688 (19%)	13,060 (14%)
Above Normal	37,640 (141%)	34,571 (116%)
Below Normal	6,782 (106%)	5,987 (84%)
Dry	9,577 (58%)	8,383 (48%)
Critical	-626 (-5%)	995 (10%)
All Years	19,379 (51%)	17,769 (45%)
Shading indicates entrainment increased 10% or more.		
<sup>a</sup> Estimated annual number of fish lost, based on normalized data.		

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential  
6 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the  
7 effects would be minimal because the north Delta intakes would have state-of-the-art screens to  
8 exclude juvenile fish.

9 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

10 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential  
11 entrainment and impingement effects for juvenile salmonids would be minimal because intakes  
12 would have state-of-the-art screens installed.

13 **NEPA Effects:** In conclusion, due to increased entrainment (average 45% increase) of juvenile  
14 spring-run Chinook salmon at the south Delta facilities, the effect of Alternative 3 would be adverse.

15 **CEQA Conclusion:** Due to increased entrainment (average 51% increase) compared to Existing  
16 Conditions, the impact of Alternative 3 on spring-run Chinook entrainment would be significant.

17 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
18 **Chinook Salmon (Spring-Run ESU)**

19 In general, Alternative 3 would reduce spawning and egg incubation habitat for spring-run Chinook  
20 salmon relative to NAA.

21 **Sacramento River**

22 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
23 salmon spawning and incubation period (September through January). Flows under A3\_LLT would  
24 be generally greater than and similar to flows NAA in October, December, and January, except in  
25 critical water years during January (8% lower) (Appendix 11C, CALSIM II Model Results utilized in  
26 the Fish Analysis).

27 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam  
28 during the spring-run spawning and egg incubation period (September through January). Storage

1 volume at the end of September would be 9% lower than under NAA in below normal water years,  
2 but would be similar to or greater than storage under NAA in other water year types depending on  
3 water year type (Table 11-3-16).

4 **Table 11-3-16. Difference and Percent Difference in September Water Storage Volume (thousand**  
5 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-286 (-9%)	226 (8%)
Above Normal	-484 (-15%)	131 (5%)
Below Normal	-587 (-20%)	-233 (-9%)
Dry	-544 (-22%)	-33 (-2%)
Critical	-392 (-33%)	-10 (-1%)

6

7 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
8 Alternative 1A, Impact AQUA-58, which indicates that there would generally be no effects of  
9 Alternative 3 on water temperatures during the spring-run spawning and egg incubation period in  
10 the Sacramento River, compared to NAA.

11 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
12 Sacramento River under A3\_LLT would be lower than or similar to mortality under NAA in dry and  
13 critical years, but greater in wet (39% greater), above normal (20% greater), and below normal  
14 (33% greater) water years (Table 11-3-17).

15 **Table 11-3-17. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**  
16 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	24 (241%)	10 (39%)
Above Normal	29 (219%)	7 (20%)
Below Normal	43 (361%)	14 (33%)
Dry	55 (278%)	-2 (-3%)
Critical	22 (30%)	0 (0%)
All	35 (155%)	6 (12%)

17

18 SacEFT predicts that there would be a 69% increase in the percentage of years with good spawning  
19 availability, measured as weighted usable area, under A3\_LLT relative to NAA (Table 11-3-18).  
20 SacEFT predicts that there would be no differences in the percentage of years with good (lower)  
21 redd scour risk under A3\_LLT relative to NAA. SacEFT predicts that there would be a 41% decrease  
22 in the percentage of years with good (lower) egg incubation conditions under A3\_LLT relative to  
23 NAA. SacEFT predicts that there would be an 18% increase in the percentage of years with good  
24 (lower) redd dewatering risk under A3\_LLT relative to NAA. These results indicate that all spawning  
25 and egg habitat metrics except egg incubation conditions would improve or not change under  
26 Alternative 3 relative to NAA.

1 **Table 11-3-18. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
2 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Spawning WUA	13 (19%)	34 (69%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-66 (-77%)	-14 (-41%)
Redd Dewatering Risk	-9 (-18%)	6 (18%)
Juvenile Rearing WUA	-2 (-9%)	-2 (-9%)
Juvenile Stranding Risk	-5 (-26%)	0 (0%)

WUA = Weighted Usable Area.

3

4 ***Clear Creek***

5 Flows in Clear Creek were examined during the spring-run Chinook salmon spawning and egg  
6 incubation period (September through January). Flows under A3\_LLT would be similar to or greater  
7 than flows under NAA except in critical years during September (13% decrease) (Appendix 11C,  
8 CALSIM II Model Results utilized in the Fish Analysis).

9 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
10 comparing the magnitude of flow reduction each month over the incubation period compared to the  
11 flow in September when spawning is assumed to occur. The greatest reduction in flows under  
12 A3\_LLT would be the same or of a lower magnitude as that under NAA in all water year types (Table  
13 11-3-19).

14 Water temperatures were not modeled in Clear Creek.

15 **Table 11-3-19. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**  
16 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**  
17 **January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

18

19 ***Feather River***

20 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)  
21 where spring-run primarily spawn during September through January (Appendix 11C, CALSIM II  
22 Model Results utilized in the Fish Analysis). Flows under A3\_LLT would not differ from NAA because

1 minimum Feather River flows are included in the FERC settlement agreement and would be met for  
2 all model scenarios (California Department of Water Resources 2006).

3 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam  
4 during the spring-run spawning and egg incubation period. Storage under A3\_LL1T would be 17% to  
5 32% greater than storage under NAA depending on water year type (Table 11-3-20).

6 **Table 11-3-20. Difference and Percent Difference in September Water Storage Volume (thousand**  
7 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A3_LL1T	NAA vs. A3_LL1T
Wet	-477 (-16%)	537 (28%)
Above Normal	-482 (-20%)	309 (20%)
Below Normal	-372 (-18%)	237 (17%)
Dry	-30 (-2%)	323 (32%)
Critical	-40 (-4%)	148 (19%)

8  
9 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
10 comparing the magnitude of flow reduction each month over the egg incubation period compared to  
11 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
12 during October through January were identical among A3\_LL1T and NAA (Appendix 11C, CALSIM II  
13 Model Results utilized in the Fish Analysis). Therefore, there would be no effect of Alternative 3 on  
14 redd dewatering in the Feather River low-flow channel.

15 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
16 Alternative 1A, Impact AQUA-58, which indicates that there would be no effect of Alternative 3 on  
17 water temperatures in the Feather River relative to NAA during the spring-run spawning and egg  
18 incubation period, compared to NAA.

19 **NEPA Effects:** Collectively, these results indicate that the effect is adverse because it has the  
20 potential to substantially reduce the quantity and quality of spawning and egg incubation habitat.  
21 Although comparisons of mean flows and water temperatures in the Sacramento River indicate that  
22 there would not be differences between NAA and Alternative 3, the Reclamation egg mortality  
23 model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under  
24 Alternative 3 would be higher than mortality under NAA by up to 14% (absolute scale) depending  
25 on water year type and by 6% (absolute scale) with all water years combined (Table 11-3-17).  
26 Further, SacEFT predicts that the number of years with good egg incubation conditions would  
27 decline under Alternative 3 by 41% (14% on an absolute scale) (Table 11-3-18). There would be no  
28 biologically meaningful effects on spring-run Chinook salmon in Clear Creek or the Feather River.

29 This effect is a result of the specific reservoir operations and resulting flows associated with this  
30 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
31 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
32 the alternative, thereby making it a different alternative than that which has been modeled and  
33 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
34 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-58a through AQUA-  
35 58c) has the potential to reduce the severity of impact, although not necessarily to a not adverse  
36 level.

1 **CEQA Conclusion:** In general, Alternative 3 would reduce spawning and egg incubation habitat  
2 conditions for spring-run Chinook salmon relative to the Existing Conditions.

### 3 **Sacramento River**

4 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
5 salmon spawning and incubation period (September through January). Flows under A3\_LLT would  
6 be similar to or greater than flows under Existing Conditions during October, December, and January  
7 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows under A3\_LLT would  
8 be mostly lower by up to 23% than those under Existing Conditions during September and  
9 November depending on water year type.

10 Shasta Reservoir Storage volume at the end of September under A3\_LLT would be 9% to 33% lower  
11 relative to Existing Conditions depending on water year type (Table 11-3-16).

12 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
13 Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the  
14 exceedances of NMFS temperature thresholds under Alternative 3 relative to Existing Conditions.

15 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
16 Sacramento River under A3\_LLT would be 30% to 361% greater than mortality under Existing  
17 Conditions depending on water year type (Table 11-3-17).

18 SacEFT predicts that there would be a 19% increase in the percentage of years with good spawning  
19 availability, measured as weighted usable area, under A3\_LLT relative to Existing Conditions (Table  
20 11-3-18). SacEFT predicts that there would be no difference in the percentage of years with good  
21 (lower) redd scour risk under A3\_LLT relative to Existing Conditions. SacEFT predicts that there  
22 would be a 77% decrease in the percentage of years with good (lower) egg incubation conditions  
23 under A3\_LLT relative to Existing Conditions, respectively. SacEFT predicts that there would be an  
24 18% decrease in the percentage of years with good (lower) redd dewatering risk under A3\_LLT  
25 relative to Existing Conditions. These results indicate that spawning and egg habitat conditions for  
26 spring-run Chinook salmon would be better for some metrics and worse for other metrics under  
27 Alternative 3 relative to the Existing Conditions.

### 28 **Clear Creek**

29 Water temperatures were not modeled in Clear Creek.

30 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
31 (September through January) under A3\_LLT would generally be similar to or greater than flows  
32 under Existing Conditions except in critical years during September (37% reduction) (Appendix 11C,  
33 CALSIM II Model Results utilized in the Fish Analysis).

34 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
35 comparing the magnitude of flow reduction each month over the incubation period compared to the  
36 flow in September when spawning is assumed to occur. The greatest reduction in flows under  
37 A3\_LLT would be similar to or lower magnitude than that under Existing Conditions in wet and  
38 below normal water years (Table 11-3-19). The greatest reduction in flows under A3\_LLT would be  
39 27–67% lower (more negative) than Existing Conditions in above normal, dry, and critical water  
40 years.

1 **Feather River**

2 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
3 Alternative 1A, Impact AQUA-58, which indicates that there would be increases in the exceedances  
4 of NMFS temperature thresholds under Alternative 3 relative to Existing Conditions.

5 Flows in the Feather River low-flow channel under A3\_LLT are not different from Existing  
6 Conditions during the spring-run spawning and egg incubation period (September through January)  
7 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows in October through  
8 January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for  
9 all model scenarios.

10 Oroville Reservoir storage volume at the end of September under A3\_LLT would be similar to  
11 storage under Existing Conditions in dry and critical years but 16–20% lower in wet, above normal,  
12 and below normal years depending on water year type (Table 11-3-20).

13 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
14 comparing the magnitude of flow reduction each month over the incubation period compared to the  
15 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
16 during October through January were identical between A3\_LLT and Existing Conditions (Appendix  
17 11C, CALSIM II Model Results utilized in the Fish Analysis). Therefore, Alternative 3 would have no  
18 impact on redd dewatering in the Feather River low-flow channel.

19 **Summary of CEQA Conclusion**

20 Collectively, these results indicate that the effect is significant because it has the potential to  
21 substantially reduce the quantity and quality of spawning and egg incubation habitat. The  
22 Reclamation egg mortality model predicts that egg mortality would increase in the Sacramento  
23 River by up to 22% to 55% (absolute scale) depending on water year type (Table 11-3-17). SacEFT  
24 predicts that the number of years with good egg incubation conditions would decline under  
25 Alternative 3 by 77% (66% on an absolute scale) (Table 11-3-18). There would be no biologically  
26 meaningful effects in Clear Creek or the Feather River.

27 This impact is a result of the specific reservoir operations and resulting flows associated with this  
28 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
29 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
30 change the alternative, thereby making it a different alternative than that which has been modeled  
31 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
32 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
33 severity of impact though not necessarily to a less-than-significant level.

34 **Mitigation Measure AQUA-58a: Following Initial Operations of CM1, Conduct Additional**  
35 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**  
36 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat.**

37 Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
38 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
39 the best available scientific information at the time and may prove to have been overstated.  
40 Upon the commencement of operations of CM1 and continuing through the life of the permit, the  
41 BDCP proponents will monitor effects on rearing habitat in order to determine whether such  
42 effects would be as extensive as concluded at the time of preparation of this document and to

1 determine any potentially feasible means of reducing the severity of such effects. This mitigation  
2 measure requires a series of actions to accomplish these purposes, consistent with the  
3 operational framework for Alternative 3.

4 The development and implementation of any mitigation actions shall be focused on those  
5 incremental effects attributable to implementation of Alternative 3 operations only.  
6 Development of mitigation actions for the incremental impact on spawning habitat attributable  
7 to climate change/sea level rise are not required because these changed conditions would occur  
8 with or without implementation of Alternative 3.

9 **Mitigation Measure AQUA-58b: Conduct Additional Evaluation and Modeling of Impacts**  
10 **on Spring-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1.**

11 Following commencement of initial operations of CM1 and continuing through the life of the  
12 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
13 modified operations could reduce impacts to spawning habitat under Alternative 3. The analysis  
14 required under this measure may be conducted as a part of the Adaptive Management and  
15 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

16 **Mitigation Measure AQUA-58c: Consult With NMFS, USFWS and CDFW to Identify and**  
17 **Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon**  
18 **Spawning Habitat Consistent With CM1**

19 In order to determine the feasibility of reducing the effects of CM1 operations on spring-run  
20 Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS, and CDFW to  
21 identify and implement any feasible operational means to minimize effects on spawning habitat.  
22 Any such action will be developed in conjunction with the ongoing monitoring and evaluation of  
23 habitat conditions required by Mitigation Measure AQUA-58a Alternative 3.

24 If feasible means are identified to reduce impacts on spawning habitat consistent with the  
25 overall operational framework of Alternative 3 without causing new significant adverse impacts  
26 on other covered species, such means shall be implemented. If sufficient operational flexibility  
27 to reduce effects on steelhead habitat is not feasible under Alternative 3 operations, achieving  
28 further impact reduction pursuant to this mitigation measure would not be feasible under this  
29 Alternative, and the impact on spring-run Chinook salmon would remain significant and  
30 unavoidable.

31 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**  
32 **Run ESU)**

33 In general, Alternative 3 would not affect the quantity and quality of rearing habitat for fry and  
34 juvenile spring-run Chinook salmon relative to NAA.

35 ***Sacramento River***

36 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
37 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
38 Bluff (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows during November  
39 are lower than under NAA in both locations and generally similar to those under NAA in all other  
40 months.

1 As reported in Impact AQUA-40, May Shasta storage volume under A3\_LLT would similar to or  
2 greater than storage under NAA for all water year types except below normal (8% lower) and dry  
3 (6% lower) (Table 11-3-9).

4 As reported in Impact AQUA-58, September Shasta storage volume under A3\_LLT would be 9%  
5 lower than under NAA in below normal water years, but would be similar to or greater than storage  
6 under NAA in other water year types depending on water year type (Table 11-3-16).

7 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
8 Alternative 1A, Impact AQUA-59, which indicates that there would be no differences (<5%) in mean  
9 monthly water temperature between NAA and Alternative 3 in any month or water year type  
10 throughout the period.

11 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under  
12 A3\_LLT would be 9% lower (2% on an absolute scale) than that under NAA (Table 11-3-18). The  
13 percentage of years with good (lower) juvenile stranding risk conditions under A3\_LLT would not  
14 be different than the percentage of years under NAA. These results indicate that there would be no  
15 effect on juvenile rearing habitat.

16 SALMOD predicts that spring-run smolt equivalent habitat-related mortality would be similar (<5%  
17 difference) between A3\_LLT and NAA.

#### 18 ***Clear Creek***

19 Flows in Clear Creek during the November through March rearing period under A3\_LLT would  
20 generally be similar to or greater than flows under NAA, except in below normal water years during  
21 March (6% lower) and critical years in February (6% lower) (Appendix 11C, CALSIM II Model  
22 Results utilized in the Fish Analysis).

23 Water temperatures were not modeled in Clear Creek.

#### 24 ***Feather River***

25 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
26 channel) during November through June were reviewed to determine flow-related effects on larval  
27 and juvenile spring-run Chinook salmon rearing period (Appendix 11C, CALSIM II Model Results  
28 utilized in the Fish Analysis). Relatively constant flows in the low-flow channel throughout this  
29 period under A3\_LLT would not differ from those under NAA. In the high-flow channel, flows under  
30 A3\_LLT would be generally be similar to or greater than flows under NAA except in above normal  
31 water years during November (8% lower) and in critical years during January (20% lower).

32 May Oroville storage under A3\_LLT would be similar to (<5% difference) storage under NAA in all  
33 water year types (Table 11-3-21).

34 As reported in Impact AQUA-58, September Oroville storage volume would be 17% to 32% greater  
35 than storage under NAA depending on water year type (Table 11-3-20).

1 **Table 11-3-21. Difference and Percent Difference in May Water Storage Volume (thousand acre-**  
2 **feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-83 (-2%)	-37 (-1%)
Above Normal	-217 (-6%)	-61 (-2%)
Below Normal	-343 (-11%)	10 (0%)
Dry	-444 (-16%)	76 (3%)
Critical	-255 (-14%)	61 (4%)

3  
4 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
5 Alternative 1A Impact AQUA-59, which indicates that mean monthly water temperatures would  
6 generally be similar between NAA and Alternative 3 during the period.

7 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because habitat would  
8 not be substantially reduced. There would be no effect of Alternative 3 compared to NAA on flows in  
9 the Sacramento and Feather Rivers or in Clear Creek. Further, there would be no effects of  
10 Alternative 3 compared to NAA on water temperatures in the Sacramento or Feather Rivers.

11 **CEQA Conclusion:** In general, Alternative 3 would not affect the quantity and quality of rearing  
12 habitat for fry and juvenile spring-run Chinook salmon relative to Existing Conditions.

13 **Sacramento River**

14 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
15 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
16 Bluff (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows under A3\_LLT  
17 would be generally similar to or greater than those under Existing Conditions with some exceptions,  
18 although flows during November would be lower (up to 27% lower depending on month, water year  
19 type, and location) than those under Existing Conditions.

20 As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A3\_LLT  
21 would be similar to Existing Conditions in wet and above normal water years, but lower by 13% to  
22 24% in below normal, dry, and critical water years (Table 11-3-9). As reported in Impact AQUA-59,  
23 storage volume at the end of September under A3\_LLT would be 9% to 33% lower relative to  
24 Existing Conditions depending on water year type (Table 11-3-16).

25 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
26 Alternative 1A, Impact AQUA-59, which indicates that there would be no differences in mean  
27 monthly water temperature between Existing Conditions and Alternative 3.

28 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under  
29 A3\_LLT would be 9% lower (2% on an absolute scale) than that under Existing Conditions, which  
30 would be negligible (Table 11-3-18). The percentage of years with good (lower) juvenile stranding  
31 risk conditions under A3\_LLT would be 26% lower (5% reduction on an absolute scale) than under  
32 Existing Conditions, which would be a small effect.

33 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A3\_LLT would be  
34 7% greater than under Existing Conditions.

1 **Clear Creek**

2 Flows in Clear Creek during the November through March rearing period under A3\_LLT would  
3 generally be similar to or greater than flows under Existing Conditions (Appendix 11C, CALSIM II  
4 Model Results utilized in the Fish Analysis).

5 Water temperatures were not modeled in Clear Creek.

6 **Feather River**

7 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
8 channel) during November through June were reviewed to determine flow-related effects on larval  
9 and juvenile spring-run rearing period (Appendix 11C, CALSIM II Model Results utilized in the Fish  
10 Analysis). Relatively constant flows in the low flow channel throughout this period under A3\_LLT  
11 would not differ from those under Existing Conditions. In the high flow channel, flows under A3\_LLT  
12 would generally be greater than or similar to flows under Existing Conditions with some exceptions,  
13 during which flows would be up to 36% lower under A3\_LLT.

14 May Oroville storage volume under A3\_LLT would be 6% to 16% lower than storage under Existing  
15 Conditions in all but wet years, in which storage would be similar to Existing Conditions (Table 11-  
16 3-21).

17 As reported in Impact AQUA-58, Oroville Reservoir storage volume at the end of September under  
18 A3\_LLT would be similar to storage under Existing Conditions in dry and critical years but 16% to  
19 20% lower in wet, above normal, and below normal years depending on water year type (Table 11-  
20 3-20).

21 Collectively, these results indicate that the impact would be less than significant and no mitigation  
22 would be necessary because habitat would not be substantially reduced. Although rearing habitat  
23 conditions in the Sacramento River would be slightly reduced by Alternative 3as predicted by  
24 SacEFT and SALMOD, there would be no other effects of Alternative 3 in any waterway.

25 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
26 **(Spring-Run ESU)**

27 **Upstream of the Delta**

28 In general, the effects of Alternative 3 on spring-run Chinook salmon migration conditions relative  
29 to the NAA are uncertain.

30 **Sacramento River**

31 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through  
32 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*  
33 *utilized in the Fish Analysis*). Flows under A3\_LLT would be similar to or greater than flows under  
34 NAA, except in critical years during January (8% lower).

35 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through  
36 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*  
37 *Model Results utilized in the Fish Analysis*). Flows during April through July under A3\_LLT would  
38 generally be similar to or greater than NAA except in dry water years during July (14% lower).  
39 Flows during August under A3\_LLT would generally be lower than NAA by up to 18%.

1 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
2 Alternative 1A Impact AQUA-60, which indicates that there would be no differences (<5%) in mean  
3 monthly water temperature between NAA and Alternative 3.

#### 4 **Clear Creek**

5 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
6 migration period under A3\_LLT would generally be similar to or greater than flows under NAA  
7 except in critical water years during February and below normal water years during March (6%  
8 lower in both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
10 migration period under A3\_LLT would be similar to or greater than flows under NAA in all months  
11 and water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Water temperatures were not modeled in Clear Creek.

#### 13 **Feather River**

14 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
15 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,  
16 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be greater  
17 than or similar to flows under NAA, except in above normal water years during November (6%  
18 lower) and in critical water years during January (8% lower).

19 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
20 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
21 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT during April through June  
22 would generally be similar to or greater than flows under NAA, except in critical years during June  
23 (8% lower). Flows under A3\_LLT during July and August would be lower than flows under NAA by  
24 up to 48% regardless of water year type.

25 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
26 Alternative 1A Impact AQUA-60, which indicates that there would be no differences in mean  
27 monthly water temperature between NAA and Alternative 3.

#### 28 **Through-Delta**

29 The effects on through-Delta migration were evaluated using the approach described in Alternative  
30 1A, Impact AQUA-42.

#### 31 **Juveniles**

32 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows  
33 below the north Delta intakes compared to baseline conditions. The two intake structures of  
34 Alternative 3 would replace aquatic habitat and likely attract piscivorous fish around the intake  
35 structures, as described above in Impact AQUA-42. Potential predation losses, as estimated by the  
36 bioenergetics model, would be 0.6% of the annual juvenile production estimated for the Sacramento  
37 Valley (Impact AQUA-42, Table 11-3-12). A conservative assumption of 5% loss per intake would  
38 yield a cumulative loss of 8.3% of juvenile spring-run Chinook that reach the north Delta. This  
39 assumption is uncertain and represents an upper bound estimate.

1 Through-Delta survival to Chipps Island (DPM) by emigrating juvenile spring-run Chinook salmon  
 2 under Alternative 3 would average 29.5% across all years, 24.1% in drier years, and 38.3% in wetter  
 3 years (Table 11-3-22). Compared to NAA, juvenile survival would be similar or slightly lower under  
 4 Alternative 3 (up to 2.1% lower in wetter years, a 5% relative decrease).

5 **Table 11-3-22. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**  
 6 **under Alternative 3**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A3_LL	EXISTING CONDITIONS vs. A3_LL	NAA vs. A3_LL
Wetter Years	42.1	40.4	38.3	-3.8 (-9%)	-2.1 (-5%)
Drier Years	24.8	24.3	24.1	-0.6 (-2%)	-0.2 (-1%)
All Years	31.3	30.3	29.5	-1.8 (-6%)	-0.9 (-3%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

7

8 **Adults**

9 During the overall spring-run upstream migration from March-June, the proportion of Sacramento  
 10 River in the Delta would be similar to NAA throughout the adult migration period (Table 11-3-14).  
 11 Olfactory cues for spring-run Chinook salmon adults would be strong, as the proportion of  
 12 Sacramento River under Alternative 3 would represent 61–69% of Delta outflows. This topic is  
 13 discussed further in Impact AQUA-42 for Alternative 1A.

14 **NEPA Effects:** Upstream of the Delta, these results indicate that the effect would not be adverse  
 15 because it does not have the potential to substantially interfere with the movement of fish. There  
 16 would be decreases in flows during 2 of 5 months of the adult upstream migration period in the  
 17 Feather River. However, there would be no other effects of Alternative 3 in the Feather River and no  
 18 effects on flows or temperatures in the Sacramento River and in Clear Creek.

19 Near-field effects of Alternative 3 NDD on spring-run Chinook salmon related to impingement and  
 20 predation associated with three new intake structures could result in negative effects on juvenile  
 21 migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall  
 22 effects. It is expected that the level of near-field impacts would be directly correlated to the number  
 23 of new intake structures in the river and thus the level of impacts associated with 2 new intakes  
 24 would be considerably lower than those expected from having 5 new intakes in the river. Estimates  
 25 within the effects analysis range from very low levels of effects (<1% mortality) to more significant  
 26 effects (~ 8% mortality above current baseline levels). CM15 would be implemented with the intent  
 27 of providing localized and temporary reductions in predation pressure at the NDD. Additionally,  
 28 several pre-construction surveys to better understand how to minimize losses associated with the 2  
 29 new intake structures will be implemented as part of the final NDD screen design effort. Alternative  
 30 3 also includes an Adaptive Management Program and Real-Time Operational Decision-Making  
 31 Process to evaluate and make limited adjustments intended to provide adequate migration  
 32 conditions for spring-run Chinook. However, at this time, due to the absence of comparable facilities

1 anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field  
2 effects at the NDD remains highly uncertain.

3 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
4 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
5 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 3  
6 predict improvements in smolt condition and survival associated with increased access to the Yolo  
7 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
8 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
9 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

10 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
11 all of these elements of BDCP operations and conservation measures to predict smolt migration  
12 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
13 migration survival under Alternative 3 would be similar to those estimated for NAA. Further  
14 refinement and testing of the DPM, along with several ongoing and planned studies related to  
15 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
16 future. These efforts are expected to improve our understanding of the relationships and  
17 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
18 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
19 However, until these efforts are completed and their results are fully analyzed, the overall  
20 cumulative effect of Alternative 3 on spring-run Chinook salmon migration remains uncertain.

21 **CEQA Conclusion:** In general, under Alternative 3 water operations, the quantity and quality of  
22 migration habitat for spring-run Chinook salmon would not be affected relative to the CEQA  
23 baseline.

## 24 **Upstream of the Delta**

### 25 ***Sacramento River***

26 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through  
27 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*  
28 *utilized in the Fish Analysis*). Flows under A3\_LLT would generally be similar to or greater than flows  
29 under Existing Conditions except in wet water years during May (14% lower).

30 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through  
31 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*  
32 *Model Results utilized in the Fish Analysis*). Flows during April through July under A3\_LLT would  
33 generally be similar to or greater than Existing Conditions, except in wet years during May (14%  
34 lower) and in dry and critical water years during July (6% and 10% lower, respectively). Flows  
35 under A3\_LLT during August are mostly lower than Existing Conditions by up to 24%.

36 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
37 Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean  
38 monthly water temperature between NAA and Alternative 1A.

1 **Clear Creek**

2 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
3 migration period under A3\_LLT would be similar to or greater than flows under Existing Conditions  
4 in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
6 migration period under A3\_LLT would generally be similar to or greater than flows under Existing  
7 Conditions with exceptions during August of critical water years (17% reduction) (Appendix 11C,  
8 *CALSIM II Model Results utilized in the Fish Analysis*).

9 Water temperatures were not modeled in Clear Creek.

10 **Feather River**

11 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
12 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,  
13 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be similar  
14 to or greater than flows under Existing Conditions, except in wet years during November and May  
15 (12% and 24% lower, respectively) and in below normal water years during November, January,  
16 and March (11%, 10%, and 12% lower, respectively).

17 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
18 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
19 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April and May under A3\_LLT  
20 would generally be similar to or greater than flows under Existing Conditions except in wet years  
21 during May (24% lower). Flows during June through August would generally be lower than flows  
22 under Existing Conditions by up to 54%.

23 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
24 Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean  
25 monthly water temperature between Existing Conditions and Alternative 1A.

26 **Through-Delta**

27 Please see the *CEQA Conclusion* above for winter-run Chinook salmon (Alternative 3, Impact AQUA-  
28 42). As described above for adult Chinook salmon winter-run upstream migration, the impact on  
29 emigrating spring-run Chinook salmon juveniles through the Delta under Alternative 3 would be  
30 less than significant.

31 **Summary of CEQA Conclusion**

32 Collectively, the results of the Impact AQUA-60 CEQA analysis indicate that the difference between  
33 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
34 alternative could substantially reduce migration habitat and substantially interfere with the  
35 movement of fish, contrary to the NEPA conclusion set forth above. There would generally be no  
36 effects of Alternative 3 on flows in the Sacramento River and Clear Creek and temperatures in the  
37 Sacramento and Feather rivers. However, flows in the Feather River would be up to 54% lower  
38 during 3 of the 5 months of the adult migration period. There would also be no substantial effects of  
39 Alternative 3 on through-Delta migration conditions for winter-run Chinook salmon.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 3 indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on migration habitat for winter-run Chinook salmon. This impact is  
20 found to be less than significant and no mitigation is required.

#### 21 **Restoration Measures (CM2, CM4–CM7, and CM10)**

22 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
23 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
24 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
25 restoration measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-  
26 61 through AQUA-63) also appropriately characterize effects under Alternative 3.

27 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

#### 28 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon** 29 **(Spring-Run ESU)**

#### 30 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook** 31 **Salmon (Spring-Run ESU)**

#### 32 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

33 **NEPA Effects:** All of these effects have been determined to result in no adverse effects on spring-run  
34 Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A. Specifically for  
35 AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to selenium,  
36 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run  
37 Chinook salmon are uncertain.

38 **CEQA Conclusions:** Overall the effects would be considered less than significant for CEQA purposes  
39 for the reasons identified for Alternative 1A.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
3 differences in other conservation-related fish effects are anticipated anywhere in the affected  
4 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
5 effects of other conservation measures described for spring-run Chinook salmon under Alternative  
6 1A (Impact AQUA-64 through AQUA-72) also appropriately characterize effects under Alternative 3.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

8 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
9 **ESU) (CM12)**

10 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
11 **(Spring-Run ESU) (CM13)**

12 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
13 **Run ESU) (CM14)**

14 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
15 **(Spring-Run ESU) (CM15)**

16 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
17 **(CM16)**

18 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
19 **(CM17)**

20 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
21 **(CM18)**

22 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
23 **ESU) (CM19)**

24 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
25 **(Spring-Run ESU) (CM21)**

26 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
27 adverse effect, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the  
28 reasons identified for Alternative 1A.

29 **CEQA Conclusions:** The nine impact mechanisms would be considered to range from no impact, to  
30 less than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for  
31 Alternative 1A, and no mitigation is required.

## 1 **Fall-/Late Fall–Run Chinook Salmon**

### 2 **Construction and Maintenance of CM1**

#### 3 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 4 **(Fall-/Late Fall–Run ESU)**

5 The potential effects of construction of water conveyance facilities on fall-run/late fall run Chinook  
6 salmon under Alternative 3 would be similar to those described for Alternative 1A (see Impact  
7 AQUA-73) except that Alternative 3 would include two intakes compared to five intakes under  
8 Alternative 1A, so the effects would be proportionally less under this alternative. This would convert  
9 about 4,450 lineal feet of existing shoreline habitat into intake facility structures and would require  
10 about 10.2 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900  
11 lineal feet of shoreline and would require 27.3 acres of dredging. The effects related to temporary  
12 increases in turbidity, accidental spills, underwater noise, in-water work activities, and disturbance  
13 of contaminated sediments would be similar to Alternative 1A and the same environmental  
14 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
15 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
16 effects.

17 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-73, environmental commitments and  
18 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
19 not be adverse for fall-run/late fall run Chinook salmon.

20 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-73, the impact of construction of the  
21 water conveyance facilities on fall-run/late fall-run Chinook salmon would be less than significant  
22 except for construction noise associated with pile driving. Potential pile driving impacts would be  
23 less than Alternative 1A because only two intakes would be constructed under Alternative 3 rather  
24 than five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would  
25 reduce that noise impact to less than significant.

#### 26 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 27 **of Pile Driving and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
29 Alternative 1A.

#### 30 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 31 **and Other Construction-Related Underwater Noise**

32 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
33 Alternative 1A.

#### 34 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 35 **(Fall-/Late Fall–Run ESU)**

36 The maintenance-related effects of Alternative 3 would be identical for all four Chinook salmon  
37 ESUs. Accordingly, for a discussion of the impacts, please refer to the discussion for winter-run  
38 Chinook (Alternative 3, Impact AQUA-38).

1 **Water Operations of CM1**

2 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
3 **Fall-Run ESU)**

4 ***Fall-Run Chinook Salmon***

5 *Water Exports from SWP/CVP South Delta Facilities*

6 Entrainment at Delta export facilities would increase 19% (11,000 more fish entrained) across all  
7 water year types compared to NAA (Table 11-3-23). When compared to NAA entrainment would be  
8 highest in above normal water years, increasing by 52–58%, and lowest in critical water year types,  
9 decreasing by 11–18% (Table 11-3-23). Pre-screen losses, typically attributed to predation, would  
10 be expected to change commensurate with entrainment at the south Delta facilities.

11 Under the assumption that the annual number of juvenile fall-run Chinook salmon juveniles  
12 approaching the Delta was 23 million fish, the percentage of the population lost to entrainment  
13 across all years averaged 0.24% under baseline scenarios and increased slightly (0.05%) under  
14 Alternative 3.

15 *Water Exports from SWP/CVP North Delta Intake Facilities*

16 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential  
17 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the  
18 effects would be minimal because the north Delta intakes would have state-of-the-art screens to  
19 exclude juvenile fish.

20 *Water Export with a Dual Conveyance for the SWP North Bay Aqueduct*

21 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential  
22 entrainment and impingement effects for juvenile salmonids would be minimal because intakes  
23 would have state-of-the-art screens installed.

24 ***Late Fall-Run Chinook Salmon***

25 *Water Exports from SWP/CVP South Delta Facilities*

26 Alternative 3 would reduce the overall entrainment of juvenile late fall-run Chinook salmon at the  
27 south Delta export facilities by 14% (~260 fish) across all water year types compared to NAA (Table  
28 11-3-23). Entrainment for late fall-run Chinook salmon would be greatest in wet years and one to  
29 two orders of magnitude less in other water year types (Table 11-3-23). Under Alternative 3,  
30 entrainment of juvenile late fall-run Chinook salmon in wet years would decrease 20% compared to  
31 NAA. The greatest relative reductions for late fall-run Chinook salmon would occur in critical water  
32 years (decreased by 22%). Pre-screen loss at the south Delta facilities, which is typically attributed  
33 to predation, would decrease commensurate with reductions in entrainment.

34 The proportion of the annual late fall-run Chinook population (assumed to be 1 million juveniles  
35 approaching the Delta) lost at the south Delta facilities would be very low and similar under baseline  
36 (0.2%) and Alternative 3 (0.2%).

1 **Table 11-3-23. Juvenile Chinook Salmon Annual Entrainment Index at the SWP and CVP Salvage**  
2 **Facilities—Differences between Model Scenarios for Alternative 3**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LL1	NAA vs. A3_LL1
<b>Fall-Run Chinook Salmon</b>		
Wet	-4,379 (-3%)	-4,556 (-4%)
Above Normal	17,981 (55%)	17,507 (52%)
Below Normal	4,718 (35%)	4,359 (31%)
Dry	8,768 (45%)	7,120 (33%)
Critical	-9,249 (-23%)	-4,071 (-11%)
All Years	10,718 (20%)	10,662 (19%)
<b>Late Fall-Run Chinook Salmon</b>		
Wet	-1,244 (-21%)	-1,157 (-20%)
Above Normal	-89 (-15%)	-75 (-13%)
Below Normal	-3 (-6%)	0.4 (1%)
Dry	-8 (-6%)	8 (6%)
Critical	-46 (-28%)	-34 (-22%)
All Years	-342 (-18%)	-261 (-14%)
Shading indicates entrainment increased 10% or more.		
<sup>a</sup> Estimated annual number of fish lost, based on normalized data.		

3

4 *Water Exports from SWP/CVP North Delta Intake Facilities*

5 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential  
6 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the  
7 effects would be minimal because the north Delta intakes would have state-of-the-art screens to  
8 exclude juvenile fish.

9 *Water Export with a Dual Conveyance for the SWP North Bay Aqueduct*

10 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential  
11 entrainment and impingement effects for juvenile salmonids would be minimal because intakes  
12 would have state-of-the-art screens installed.

13 **NEPA Effects:** Under Alternative 3 the entrainment losses at the south Delta facilities would increase  
14 for fall-run Chinook salmon and decrease for late fall-run Chinook salmon compared to baseline  
15 conditions. This effect would be adverse for fall-run.

16 **CEQA Conclusion:** Entrainment losses of juvenile fall-run Chinook salmon at the south Delta export  
17 facilities would increase by approximately 20% across all water year types under Alternative 3  
18 compared to Existing Conditions (Table 11-3-23). However, entrainment of juvenile late fall-run  
19 Chinook salmon is expected to decrease by approximately 18% across all water year types under  
20 Alternative 3 compared to Existing Conditions (Table 11-3-23). Relative impacts at the north Delta  
21 intakes and the North Bay Aqueduct would be the same as under Alternative 1A. Overall, impacts  
22 would be significant for fall-run Chinook salmon and may be beneficial for late fall-run.

**Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall-Run ESU)**

In general, Alternative 3 would have negligible effects on the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to NAA.

**Sacramento River**

*Fall-Run*

Sacramento River flows upstream of Red Bluff were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows under A3\_LLT would generally be greater than or similar to NAA during October, December, and January, except for critical water years during January (8% lower). Flows during November would be lower by up to 29% in all water years.

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. Storage under A3\_LLT would be 9% lower than under NAA in below normal water years, but would be similar to or greater than storage under NAA in other water year types depending on water year type (Table 11-3-16).

Water temperatures in the Sacramento River for Alternative 3 are not different from those for Alternative 1A, Impact AQUA-76, which indicates there would be no differences in mean monthly water temperature between NAA and Alternative 1A.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A3\_LLT would lower than or similar to mortality under NAA in all water year types except below normal years (21% greater, and absolute increase of 5% of fall-run population) (Table 11-3-24). These results indicate that climate change would increase fall-run Chinook salmon egg mortality, but Alternative 3 would have small to negligible effects.

**Table 11-3-24. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	10 (103%)	0 (2%)
Above Normal	12 (110%)	1 (4%)
Below Normal	16 (148%)	5 (21%)
Dry	17 (120%)	1 (2%)
Critical	9 (30%)	-1 (-2%)
All	13 (91%)	1 (4%)

SacEFT predicts that there would be a 14% increase (5% absolute scale) in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A3\_LLT relative to NAA (Table 11-3-25). SacEFT predicts that there would be a 12% reduction (8% absolute scale) in the percentage of years with good (lower) redd scour risk under A3\_LLT, relative to NAA. SacEFT predicts that there would be no effect of A3\_LLT relative to NAA. SacEFT predicts that there would be a 7% increase (2% absolute scale) in the percentage of years with good (lower) redd dewatering risk under A3\_LLT relative to NAA, which is negligible. These

1 results indicate that there would be a small increase in years in which spawning WUA would be  
2 considered “good” and small decrease in year in which redd scour risk would be considered “good”.

3 **Table 11-3-25. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
4 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Spawning WUA	-8 (-17%)	5 (14%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-25 (-27%)	0 (0%)
Redd Dewatering Risk	2 (7%)	2 (7%)
Juvenile Rearing WUA	2 (6%)	-5 (-13%)
Juvenile Stranding Risk	-3 (-10%)	8 (40%)

WUA = Weighted Usable Area.

5

6 *Late Fall-Run*

7 Sacramento River flows upstream of Red Bluff were examined for the February through May late  
8 fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, CALSIM II Model  
9 Results utilized in the Fish Analysis. Flows under A3\_LLT would be greater than or similar to flows  
10 under NAA throughout the period.

11 Shasta Reservoir storage at the end of September would affect flows during the late fall–run  
12 spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta  
13 Reservoir storage would be 9% lower than under NAA in below normal water years, but would be  
14 similar to or greater than storage under NAA in other water year types depending on water year  
15 type (Table 11-3-16).

16 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the  
17 Sacramento River under A3\_LLT would be similar to mortality under NAA in all water years,  
18 including below normal water years in which, although there would be an 17% relative increase, the  
19 absolute increase would be 1% of the late fall–run population (Table 11-3-26).

20 **Table 11-3-26. Difference and Percent Difference in Percent Mortality of Late fall–Run Chinook**  
21 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	3 (167%)	-1 (-13%)
Above Normal	4 (155%)	-1 (-11%)
Below Normal	5 (336%)	1 (17%)
Dry	4 (160%)	-1 (-8%)
Critical	2 (127%)	0 (-7%)
All	4 (178%)	0 (-6%)

22

23 SacEFT predicts that there would be a 6% decrease (3% absolute scale) in the percentage of years  
24 with good spawning availability for late fall–run Chinook salmon, measured as weighted usable area,  
25 under A3\_LLT relative to NAA (Table 11-3-27). SacEFT predicts that there would be no difference in

1 the percentage of years with good (lower) redd scour risk under A3\_LLT, relative to NAA. SacEFT  
 2 predicts that there would be a negligible (<5%) difference in the percentage of years with good  
 3 (lower) egg incubation conditions between A3\_LLT and NAA. SacEFT predicts that there would be a  
 4 5% decrease (3% absolute scale) in the percentage of years with good (low) redd dewatering risk  
 5 under A3\_LLT, relative to NAA. These results indicate that there would be negligible effects of  
 6 Alternative 3 on spawning and egg incubation conditions for late fall-run Chinook salmon in the  
 7 Sacramento River

8 **Table 11-3-27. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
 9 **for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Spawning WUA	-7 (-13%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-8 (-13%)	-3 (-5%)
Juvenile Rearing WUA	-10 (-22%)	-28 (-44%)
Juvenile Stranding Risk	-27 (-38%)	-1 (-2%)

WUA = Weighted Usable Area.

10

11 ***Clear Creek***

12 No water temperature modeling was conducted in Clear Creek.

13 ***Fall-Run***

14 Clear Creek flows below Whiskeytown Reservoir were examined for the September through  
 15 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, CALSIM II  
 16 Model Results utilized in the Fish Analysis). Flows under A3\_LLT would be similar to or greater than  
 17 flows under NAA throughout the period.

18 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of  
 19 flow reduction each month over the incubation period compared to the flow in September when  
 20 spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during  
 21 September through February under A3\_LLT would be the same as the reduction under NAA in all  
 22 water years (Table 11-3-28).

1 **Table 11-3-28. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**  
 2 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**  
 3 **February Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 ***Feather River***

6 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
 7 Alternative 1A, Impact AQUA-76, which indicates that temperatures conditions under Alternative 1A  
 8 would be similar to or better than those under NAA.

9 ***Fall-Run***

10 Flows in the Feather River in the low flow and high flow channels were examined for the October  
 11 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,  
 12 CALSIM II Model Results utilized in the Fish Analysis). Flows in the low-flow channel under A3\_LLT  
 13 would be identical to those under NAA. Flows in the high-flow channel under A3\_LLT would  
 14 generally be similar to or greater than those under NAA except in above normal water years during  
 15 November (8% lower) and critical years during January (20% lower). These results indicate that  
 16 Alternative 3 would generally improve flow conditions for fall-run spawning and egg incubation  
 17 conditions in the Feather River high flow channel.

18 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
 19 comparing the magnitude of flow reduction each month over the incubation period compared to the  
 20 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during  
 21 November through January were identical between A3\_LLT and NAA (Appendix 11C, CALSIM II  
 22 Model Results utilized in the Fish Analysis). Therefore, there would be no effect of Alternative 3 on  
 23 redd dewatering in the Feather River low-flow channel.

24 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
 25 Feather River under A3\_LLT would be similar to or lower than mortality under NAA in all water  
 26 years, indicating a small beneficial effect of Alternative 3 on temperature conditions for incubating  
 27 eggs in the Feather River (Table 11-3-29).

**Table 11-3-29. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	5 (390%)	-14 (-67%)
Above Normal	5 (463%)	-7 (-53%)
Below Normal	12 (683%)	-1 (-6%)
Dry	15 (690%)	-4 (-17%)
Critical	21 (437%)	-2 (-7%)
All	11 (523%)	-7 (-33%)

**American River**

Water temperatures in the American River under Alternative 3 would be the same as those under Alternative 1A, which indicates that there would be no differences in mean monthly water temperature between NAA and Alternative 1A.

**Fall-Run**

Flows in the American River at the confluence with the Sacramento River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows under A3\_LLT would generally be similar to or greater than flows under NAA, except for above normal water years during November (16% lower). These results indicate that these differences are primarily due to climate change and not Alternative 3.

The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by comparing the magnitude of flow reduction each month over the incubation period compared to the flow in October when spawning is assumed to occur. The greatest reduction under A3\_LLT would be 18% to 53% greater than that under NAA depending on water year type (Table 11-3-30).

**Table 11-3-30. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in the American River at Nimbus Dam during the October through January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-41 (-189%)	-16 (-35%)
Above Normal	-17 (-57%)	-7 (-18%)
Below Normal	-42 (-219%)	-15 (-32%)
Dry	-6 (-12%)	-8 (-18%)
Critical	-9 (-18%)	-21 (-53%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
2 American River under A3\_LLТ would be similar to mortality under NAA in all water years (Table 11-  
3 3-31).

4 **Table 11-3-31. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**  
5 **Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A3_LLТ	NAA vs. A3_LLТ
Wet	25 (165%)	1 (3%)
Above Normal	22 (209%)	-1 (-2%)
Below Normal	20 (165%)	-2 (-5%)
Dry	16 (101%)	0 (0%)
Critical	9 (45%)	0 (-1%)
All	20 (129%)	0 (0%)

6

7 **Stanislaus River**

8 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
9 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
10 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLТ would be similar to  
11 flows under NAA throughout the period.

12 Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
13 Alternative 1A, which indicates that there would be no differences (<5%) in mean monthly water  
14 temperature between NAA and Alternative 1A.

15 **San Joaquin River**

16 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
17 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
18 *utilized in the Fish Analysis*). Flows under A3\_LLТ would be similar to flows under NAA throughout  
19 the period.

20 Water temperature modeling was not conducted in the San Joaquin River.

21 **Mokelumne River**

22 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
23 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
24 *utilized in the Fish Analysis*). Flows under A3\_LLТ would be similar to flows under NAA throughout  
25 the period.

26 Water temperature modeling was not conducted in the Mokelumne River.

27 **NEPA Effects:** Collectively, it is concluded that the effect is not adverse because habitat conditions  
28 are not substantially reduced. There are no reductions in flows under Alternative 3 or increases in  
29 temperatures in the rivers evaluated that would translate into biologically meaningful effects on fall-  
30 /late fall-run Chinook salmon.

1 **CEQA Conclusion:** In general, under Alternative 3 water operations, spawning and egg incubation  
2 habitat for fall-/late fall-run Chinook salmon would not be affected relative to the CEQA baseline.

3 **Sacramento River**

4 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
5 Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large increases in  
6 water temperatures under of Alternative 1A relative to Existing Conditions in the Sacramento River.

7 *Fall-Run*

8 Flows in the Sacramento River upstream of Red Bluff were examined during the October through  
9 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, CALSIM II  
10 Model Results utilized in the Fish Analysis). Flows under A3\_LLT would be greater than or similar to  
11 Existing Conditions in all water year types during October, December, and January (Appendix 11C,  
12 CALSIM II Model Results utilized in the Fish Analysis). However, flows in November under A3\_LLT  
13 would be lower in all water year types by 5% to 21%.

14 As indicated in Impact AQUA-58, Shasta Reservoir Storage volume at the end of September under  
15 A3\_LLT would be 9% to 33% lower relative to Existing Conditions depending on water year type  
16 (Table 11-3-16).

17 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
18 Sacramento River under A3\_LLT would be 30% to 148% greater than mortality under Existing  
19 Conditions (Table 11-3-24).

20 SacEFT predicts that there would be an 8% increase in the percentage of years with good spawning  
21 availability, measured as weighted usable area, under A3\_LLT relative to Existing Conditions (Table  
22 11-3-25). SacEFT predicts that there would be a 5% reduction in the percentage of years with good  
23 (lower) redd scour risk under A3\_LLT relative to Existing Conditions. SacEFT predicts that there  
24 would be a 27% reduction in the percentage of years with good (lower) egg incubation conditions  
25 under A3\_LLT relative to Existing Conditions. SacEFT predicts that there would be a 7% increase in  
26 the percentage of years with good (lower) redd dewatering risk under A3\_LLT relative to Existing  
27 Conditions.

28 *Late Fall-Run*

29 Flows in the Sacramento River upstream of Red Bluff were examined during the February through  
30 May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, CALSIM II  
31 Model Results utilized in the Fish Analysis). Flows under A3\_LLT would generally be greater than or  
32 similar to flows under Existing Conditions, except in wet years during May (14% lower).

33 Shasta Reservoir Storage volume at the end of September under A3\_LLT would be 9% to 33% lower  
34 relative to Existing Conditions depending on water year type (Table 11-3-16).

35 The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the  
36 Sacramento River under A3\_LLT would be 127% to 336% greater than mortality under Existing  
37 Conditions (Table 11-3-26). However, absolute differences in the percent of the late-fall population  
38 subject to mortality would be minimal in all but below normal years, in which there is a 5% increase.

39 SacEFT predicts that there would be a 13% decrease in the percentage of years with good spawning  
40 availability, measured as weighted usable area, under A3\_LLT relative to Existing Conditions (Table

1 11-3-23). SacEFT predicts that there would be a 7% decrease in the percentage of years with good  
2 (lower) redd scour risk under A3\_LLT relative to Existing Conditions. SacEFT predicts that there  
3 would be no difference in the percentage of years with good (lower) egg incubation conditions  
4 between A3\_LLT and Existing Conditions. SacEFT predicts that there would be a 13% decrease in  
5 the percentage of years with good (lower) redd dewatering risk under A3\_LLT relative to Existing  
6 Conditions.

### 7 ***Clear Creek***

8 No water temperature modeling was conducted in Clear Creek.

9 Fall-Run flows in Clear Creek below Whiskeytown Reservoir were reviewed during the September  
10 through February fall-run spawning and egg incubation period (Appendix 11C, CALSIM II Model  
11 Results utilized in the Fish Analysis). Flows under A3\_LLT would always be similar to or greater  
12 than flows under Existing Conditions throughout the period.

13 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of  
14 flow reduction each month over the incubation period compared to the flow in September when  
15 spawning occurred. The greatest monthly reduction in Clear Creek flows during October through  
16 February under A3\_LLT would be similar to or lower magnitude than those under Existing  
17 Conditions in wet and below normal water years, but the reduction would be 27%, 67%, and 33%  
18 greater (absolute, not relative, differences) under A3\_LLT in above normal, dry, and critical water  
19 years, respectively (Table 11-3-28).

### 20 ***Feather River***

21 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
22 Alternative 1A, which indicates that there would be moderate to large effects of Alternative 1A on  
23 temperatures.

24 Fall-Run flows in the Feather River in the low flow and high flow channels were examined for the  
25 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
26 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows in the low-flow channel A3\_LLT  
27 would be identical to those under Existing Conditions. Flows in the high-flow channel during  
28 October through December under A3\_LLT would be similar to or greater than flows under Existing  
29 Conditions, except in wet years during November and December (16% lower in both years) and in  
30 below normal years during October and November (7% and 13% lower, respectively). During  
31 January, flows would generally be lower by up to 36% than flows under Existing Conditions,  
32 although there would be increase flows in wet and dry years of 27% and 34%, respectively, which  
33 would outweigh reductions in other years.

34 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
35 comparing the magnitude of flow reduction each month over the incubation period compared to the  
36 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel would  
37 be identical between A3\_LLT and Existing Conditions (Appendix 11C, CALSIM II Model Results  
38 utilized in the Fish Analysis). Therefore, there would be no effect of Alternative 3 on redd  
39 dewatering in the Feather River low-flow channel.

40 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
41 Feather River under A3\_LLT would be 390% to 690% greater than mortality under Existing

1 Conditions, which would be a 5% to 21% increase in egg mortality on an absolute scale (Table 11-3-  
2 29).

### 3 **American River**

4 Water temperatures in the American River under Alternative 3 would be the same as those under  
5 Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large effects of  
6 Alternative 1A on temperatures.

7 Fall-Run Flows in the American River at the confluence with the Sacramento River were examined  
8 during the October through January fall-run spawning and egg incubation period (Appendix 11C,  
9 CALSIM II Model Results utilized in the Fish Analysis). Flows during November and December in the  
10 American River at the confluence with the Sacramento River under A3\_LLT would generally be  
11 lower by up to 37% than flows under NAA during November through January (Appendix 11C,  
12 CALSIM II Model Results utilized in the Fish Analysis). Flows during January would generally be  
13 similar to or greater than flows under Existing Conditions, except in dry and critical water years  
14 (12% and 17% lower, respectively).

15 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
16 comparing the magnitude of flow reduction each month over the incubation period compared to the  
17 flow in October when spawning is assumed to occur. The greatest monthly reduction in American  
18 River flows under A3\_LLT during November through January would be of greater magnitude than  
19 that under Existing Conditions in all water year types by 12% to 219% (Table 11-3-30).

20 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
21 American River under A3\_LLT would be 45% to 209% greater than mortality under Existing  
22 Conditions, which would be 9% to 25% higher on an absolute scale (Table 11-3-31).

### 23 **Stanislaus River**

24 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
25 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be up to 18% lower  
27 than those under Existing Conditions throughout the period.

28 Water temperatures in the Stanislaus River for Alternative 3 are not different from those for  
29 Alternative 1A, Impact AQUA-76, which indicates that there would be no effects of Alternative 1A on  
30 temperatures.

### 31 **San Joaquin River**

32 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
33 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
34 *utilized in the Fish Analysis*). Flows under A3\_LLT would be up to 8% lower than Existing Conditions  
35 in most water years during October, similar to Existing Conditions in November and December, and  
36 up to 6% higher than Existing Conditions during January.

37 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
3 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
4 *utilized in the Fish Analysis*). Flows under A3\_LLТ would be up to 14% lower than flows under  
5 Existing Conditions during October and November, up to 15% greater than flows under Existing  
6 Conditions during December and January.

7 Water temperature modeling was not conducted in the Mokelumne River.

8 **Summary of CEQA Conclusion**

9 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between  
10 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
11 alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA  
12 conclusion set forth above. There would be flow reductions and water temperature increases in the  
13 Sacramento River that would affect fall- and late fall-run Chinook salmon, as evidenced by  
14 Reclamation Egg Mortality model results for fall-run and SacEFT results for fall- and late fall-run  
15 Chinook salmon. Water temperatures would also be higher in the Feather and American Rivers  
16 under Alternative 3 than under the Existing Conditions that would lead to moderately higher egg  
17 mortality as predicted by the Reclamation Egg Mortality Model. Flows would be lower and water  
18 temperatures would be lower in the Stanislaus River under Alternative 3.

19 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
20 change, future water demands, and implementation of the alternative. The analysis described above  
21 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
22 alternative from those of sea level rise, climate change and future water demands using the model  
23 simulation results presented in this chapter. However, the increment of change attributable to the  
24 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
25 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLТ  
26 implementation period, which does include future sea level rise, climate change, and water  
27 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
28 the LLТ, both of which include sea level rise, climate change, and future water demands, isolates the  
29 effect of the alternative from those of sea level rise, climate change, and water demands.

30 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
31 term implementation period and Alternative 3 indicates that flows in the locations and during the  
32 months analyzed above would generally be similar between Existing Conditions during the LLТ and  
33 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
34 found above would generally be due to climate change, sea level rise, and future demand, and not  
35 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
36 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
37 result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact  
38 is found to be less than significant and no mitigation is required.

39 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
40 **(Fall-/Late Fall-Run ESU)**

41 In general, Alternative 3 would not affect the quantity and quality of larval and juvenile rearing  
42 habitat for fall-/late fall-run Chinook salmon relative to NAA.

1 **Sacramento River**

2 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
3 Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on  
4 temperature.

5 *Fall-Run*

6 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
7 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*). Flows in the Sacramento River upstream of Red Bluff under A3\_LLT would be greater than  
9 or similar to flows under NAA, except in critical water years during January (8% lower).

10 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and  
11 juvenile rearing period. Storage volume at the end of September would be 9% lower than under  
12 NAA in below normal water years, but would be similar to or greater than storage under NAA in  
13 other water year types depending on water year type (Table 11-3-13).

14 SacEFT predicts that there would be a 13% reduction (5% absolute scale) in the percentage of years  
15 with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable  
16 area, under A3\_LLT relative to NAA (Table 11-3-25). SacEFT predicts that there would be a 40%  
17 increase (8% absolute scale) in the percentage of years with “good” (lower) juvenile stranding risk  
18 under A3\_LLT relative to NAA.

19 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A3\_LLT would be  
20 7% lower than under NAA.

21 *Late Fall–Run*

22 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run  
23 Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results*  
24 *utilized in the Fish Analysis*). Flows during this period under A3\_LLT were generally similar to or  
25 greater than those under NAA.

26 Shasta Reservoir storage at the end of September and May would affect flows during the late fall–  
27 run larval and juvenile rearing period. End of September Shasta storage volume would be 9% lower  
28 than under NAA in below normal water years, but would be similar to or greater than storage under  
29 NAA in other water year types depending on water year type (Table 11-3-16).

30 May Shasta storage volume under A3\_LLT would be similar to or greater than storage under NAA for  
31 all water year types except below normal (8% lower) and dry (6% lower) (Table 11-3-9).

32 SacEFT predicts that there would be a 44% decrease (28% absolute scale) in the percentage of years  
33 with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted  
34 usable area, under A3\_LLT relative to NAA (Table 11-3-27). SacEFT predicts that the percentage of  
35 years with “good” (lower) juvenile stranding risk under A3\_LLT would be similar (<5% difference)  
36 to NAA.

37 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A3\_LLT would  
38 be similar to (<5% difference) mortality under NAA.

1       **Clear Creek**

2       No water temperature modeling was conducted in Clear Creek.

3       *Fall-Run*

4       Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
5       run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6       *Analysis*). Flows under A3\_LLT would generally be similar to or greater than flows under NAA,  
7       except in critical water years during February (6% lower) and in below normal years during March  
8       (6% reduction).

9       **Feather River**

10       Water temperatures in the Feather River under Alternative 3 would be the same as those under  
11       Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on  
12       temperature.

13       *Fall-Run*

14       Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
15       channel) during December through June were reviewed to determine flow-related effects on larval  
16       and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
17       *Analysis*). Relatively constant flows in the low flow channel throughout this period under A3\_LLT  
18       would not differ from those under NAA. In the high flow channel, flows under A3\_LLT would nearly  
19       always be similar to or greater than flows under NAA, except in critical water years during January  
20       (20% lower). These results indicate that Alternative 3 would provide moderate benefits to fall-run  
21       Chinook salmon in the Feather River.

22       As reported in Impact AQUA-59, May Oroville storage under A3\_LLT would be similar to (<5%  
23       difference) storage under NAA in all water year types (Table 11-3-22).

24       As reported in Impact AQUA-58, September Oroville storage volume would be 17% to 32% greater  
25       than storage under NAA depending on water year type (Table 11-3-20).

26       **American River**

27       Water temperatures in the American River under Alternative 3 would be the same as those under  
28       Alternative 1A, Impact AQUA-77, which indicates that there would be no effects on temperature,  
29       compared to NAA.

30       *Fall-Run*

31       Flows in the American River at the confluence with the Sacramento River were examined for the  
32       January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
33       *Results utilized in the Fish Analysis*). Flows during January through April under A3\_LLT would  
34       generally be similar to or greater than flows under NAA except in dry and critical years during  
35       March (7% and 9% lower, respectively). Flows during May under A3\_LLT would be mostly higher  
36       than flows under NAA (up to 36% lower).

1       **Stanislaus River**

2       *Fall-Run*

3       Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 3 are not  
4       different from those under NAA, for the January through May fall-run Chinook salmon juvenile  
5       rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6       Water temperatures in the Stanislaus River for Alternative 3 are not different from those for  
7       Alternative 1A, which indicates that there would be no effects on temperature or flow, relative to  
8       NAA.

9       **San Joaquin River**

10       *Fall-Run*

11       Flows in the San Joaquin River at Vernalis for Alternative 3 are not different from those under NAA,  
12       for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II*  
13       *Model Results utilized in the Fish Analysis*).

14       Water temperature modeling was not conducted in the San Joaquin River.

15       **Mokelumne River**

16       *Fall-Run*

17       Flows in the Mokelumne River at the Delta for Alternative 3 are not different from those under NAA,  
18       for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II*  
19       *Model Results utilized in the Fish Analysis*).

20       Water temperature modeling was not conducted in the Mokelumne River.

21       **NEPA Effects:** Taken together, these results indicate that the effect is not adverse because it does not  
22       have the potential to substantially reduce the amount of suitable habitat of fish. Fall-run Chinook  
23       salmon would experience beneficial effects of Alternative 3 in the Sacramento River and would not  
24       be affected in any upstream waterway. SacEFT predicts that there would be a 44% decrease (28%  
25       on an absolute scale) in the percentage of years with good juvenile rearing availability for late fall-  
26       run, although modeling outputs predict that flows, which drive rearing habitat availability, would be  
27       similar or would increase during the rearing period. In addition, the number of years with good  
28       juvenile stranding risk for late fall-run Chinook salmon as predicted by SacEFT would not differ  
29       between Alternative 3 and the NEPA baseline, nor would water temperatures or smolt equivalent  
30       habitat-related mortality as predicted by SALMOD. There are no effects of Alternative 3 on fall-run  
31       or late-fall-run Chinook salmon in other waterways.

32       **CEQA Conclusion:** In general, Alternative 3 would not affect the quantity and quality of larval and  
33       juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to the Existing Conditions.

34       **Sacramento River**

35       Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
36       Alternative 1A, Impact AQUA-77 which indicates that there would be no effects on temperatures  
37       during the evaluated period, relative to Existing Conditions.

1 *Fall-Run*

2 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
3 Chinook salmon juvenile rearing period (Appendix 11C, CALSIM II Model Results utilized in the Fish  
4 Analysis). Flows under A3\_LLT would generally be greater than or similar to flows under Existing  
5 Conditions, except in wet years during May (14% lower).

6 As reported in Impact AQUA-58, end of September Shasta Reservoir storage under A3\_LLT would be  
7 9% to 33% lower relative to Existing Conditions depending on water year type (Table 11-3-16).

8 SacEFT predicts that there would be a 6% increase in the percentage of years with good juvenile  
9 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A3\_LLT  
10 relative to Existing Conditions (Table 11-3-25). SacEFT predicts that there would be a 10%  
11 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A3\_LLT  
12 relative to Existing Conditions.

13 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A3\_LLT would be  
14 14% lower than mortality under Existing Conditions.

15 *Late Fall–Run*

16 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run  
17 Chinook salmon juvenile March through July rearing period (Appendix 11C, CALSIM II Model Results  
18 utilized in the Fish Analysis). Flows during the period under A3\_LLT were generally similar to or  
19 greater than those under Existing Conditions except for lower flows in some water years in July (up  
20 to 10% lower).

21 As reported in Impact AQUA-58, end of September Shasta Reservoir storage under A3\_LLT would be  
22 9% to 33% lower relative to Existing Conditions depending on water year type (Table 11-3-16).

23 As reported in Impact AQUA-40, end of May Shasta storage under A3\_LLT would be similar to  
24 Existing Conditions in wet and above normal water years, but lower by 13% to 24% in below  
25 normal, dry, and critical water years (Table 11-3-9).

26 SacEFT predicts that there would be a 10% reduction in the percentage of years with good juvenile  
27 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under  
28 A3\_LLT relative to Existing Conditions (Table 11-3-27). SacEFT predicts that there would be a 38%  
29 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A3\_LLT  
30 relative to Existing Conditions.

31 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A3\_LLT would  
32 be 7% higher than mortality under Existing Conditions.

33 *Clear Creek*

34 No temperature modeling was conducted in Clear Creek.

35 *Fall-Run*

36 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
37 run Chinook salmon rearing period (Appendix 11C, CALSIM II Model Results utilized in the Fish  
38 Analysis). Flows under A3\_LLT would be similar to or greater than flows under Existing Conditions  
39 for the entire period.

1 **Feather River**

2 *Fall-Run*

3 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
4 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher than under  
5 Existing Conditions during substantial portions of the periods evaluated.

6 Fall-run flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-  
7 flow channel) during December through June were reviewed to determine flow-related effects on  
8 larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
9 *Analysis*). Relatively constant flows in the low flow channel throughout the period under A3\_LLT  
10 would not differ from those under Existing Conditions. In the high flow channel, flows under A3\_LLT  
11 would be mostly lower (up to 36%) during January and mostly similar to or greater than flows  
12 under NAA during December and February through June with few exceptions during which flows  
13 would be up to 33% lower under A3\_LLT. Overall, the increases in flows would outweigh the  
14 reductions in flows under Alternative 3 relative to the Existing Conditions.

15 As reported under Impact AQUA-59, May Oroville storage volume under A3\_LLT would be 6% to  
16 16% lower than storage under Existing Conditions in all but wet years, in which storage would be  
17 similar to Existing Conditions (Table 11-3-21).

18 As reported in Impact AQUA-58, Oroville Reservoir storage volume at the end of September under  
19 A3\_LLT would be similar to storage under Existing Conditions in dry and critical years but 16% to  
20 20% lower in wet, above normal, and below normal years depending on water year type (Table 11-  
21 3-20).

22 **American River**

23 *Fall-Run*

24 Water temperatures in the American River under Alternative 3 would be the same as those under  
25 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher than under  
26 Existing Conditions in 3 months during the 5-month period evaluated.

27 Flows in the American River at the confluence with the Sacramento River were examined for the  
28 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
29 *Results utilized in the Fish Analysis*). Flows during January through April under A3\_LLT would  
30 generally be similar to or greater than flows under Existing Conditions, with few exceptions during  
31 which flows would be up to 17% lower. Flows during May under A3\_LLT would be mostly lower (by  
32 up to 27%) than flows under Existing Conditions.

33 **Stanislaus River**

34 *Fall-Run*

35 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 3 would be  
36 up to 36% lower than Existing Conditions in January through May fall-run larval and juvenile  
37 rearing period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
38 *Analysis*).

1 Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
2 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher than under  
3 Existing Conditions throughout the period evaluated.

#### 4 ***San Joaquin River***

##### 5 *Fall-Run*

6 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run  
7 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*  
8 *the Fish Analysis*). Flows under A3\_LLТ would generally be similar to flows under Existing  
9 Conditions during January and February and lower by up to 15% during March through May,  
10 particularly in drier water year types.

11 Water temperature modeling was not conducted in the San Joaquin River.

#### 12 ***Mokelumne River***

##### 13 *Fall-Run*

14 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook  
15 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
16 *Analysis*). Flows under A3\_LLТ would be up to 18% greater than those under Existing Conditions  
17 during January and February, similar to flows under Existing Conditions during March, and lower by  
18 up to 18% than flows under Existing Conditions during April and May.

19 Water temperature modeling was not conducted in the Mokelumne River.

#### 20 **Summary of CEQA Conclusion**

21 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between  
22 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
23 alternative could substantially reduce the fall-/late fall-run Chinook salmon rearing habitat,  
24 contrary to the NEPA conclusion set forth above. Fall-run Chinook salmon would experience higher  
25 egg mortality in the Sacramento River under Alternative 3 relative to Existing Conditions. Late fall-  
26 run Chinook salmon in the Sacramento River experience small to moderate (up to 24%) reductions  
27 in flow during August, September, and November in most water year types relative to the Existing  
28 Conditions. SacEFT predicts that there would be a 22% reduction (10% on an absolute scale) in  
29 years with good late fall-run Chinook salmon juvenile rearing WUA and a 38% reduction (27% on an  
30 absolute scale) in years with low juvenile stranding risk. Despite small or intermittent flow  
31 reductions, there are no impacts of Alternative 3 on flows during the fall-run or late fall-run Chinook  
32 salmon periods in the Feather, American, San Joaquin, and Mokelumne Rivers. However, water  
33 temperatures would be increased in both the Feather and American Rivers. In the Stanislaus River,  
34 flows would be reduced and water temperatures would increase throughout the period.

35 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
36 change, future water demands, and implementation of the alternative. The analysis described above  
37 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
38 alternative from those of sea level rise, climate change and future water demands using the model  
39 simulation results presented in this chapter. However, the increment of change attributable to the  
40 alternative is well informed by the results from the NEPA analysis, which found this effect to be not

1 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
2 implementation period, which does include future sea level rise, climate change, and water  
3 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
4 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
5 effect of the alternative from those of sea level rise, climate change, and water demands.

6 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
7 term implementation period and Alternative 3 indicates that flows in the locations and during the  
8 months analyzed above would generally be similar between Existing Conditions during the LLT and  
9 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
10 found above would generally be due to climate change, sea level rise, and future demand, and not  
11 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
12 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
13 result in a significant impact on rearing incubation habitat for fall-/late fall-run Chinook salmon.  
14 This impact is found to be less than significant and no mitigation is required.

### 15 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon** 16 **(Fall-/Late Fall-Run ESU)**

17 In general, Alternative 3 would reduce migration conditions for fall-/late fall-run Chinook salmon  
18 relative to NAA.

#### 19 **Upstream of the Delta**

##### 20 ***Sacramento River***

21 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
22 Alternative 1A, Impact AQUA-78, which indicates that there would be no effect on temperatures  
23 throughout the periods evaluated, relative to NAA.

##### 24 ***Fall-Run***

25 Fall-run flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run  
26 migrants during February through May. Flows under A3\_LLTT would be similar to or greater than  
27 flows under NAA throughout the juvenile fall-run migration period in all water year types (Appendix  
28 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run  
30 Chinook salmon upstream migration period (September through October). Flows during September  
31 under A3\_LLTT would generally be lower by up to 43% than those under NAA. Flows during October  
32 under A3\_LLTT would be greater than those under NAA. Because flow reductions are negligible or  
33 small in dry and critical water years, these flow reductions would not affect fall-run Chinook salmon  
34 in a biologically meaningful way.

##### 35 ***Late Fall-Run***

36 Flows in the Sacramento River upstream of Red Bluff were reviewed for juvenile late fall-run  
37 migration period (January through March). Flows under A3\_LLTT would generally be similar to or  
38 greater than flows under NAA except in critical water years during January (8% lower) (Appendix  
39 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Flows in the Sacramento River upstream of Red Bluff were reviewed for the adult late fall–run  
2 Chinook salmon upstream migration period (December through February). Flows under A3\_LLT  
3 would generally be similar to or greater than flows under NAA except in critical water years during  
4 January (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 5 **Clear Creek**

6 Water temperature modeling was not conducted in Clear Creek.

7 Fall-run flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run  
8 migrants during February through May. Flows under A3\_LLT would generally be similar to or  
9 greater than flows under NAA except in critical years during February (6% lower) and in below  
10 normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
11 *Fish Analysis*).

12 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
13 upstream migration period (September through October) under A3\_LLT would be similar to or  
14 greater than those under NAA, except in critical water years during September (13% lower).  
15 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*).

#### 16 **Feather River**

17 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
18 Alternative 1A, Impact AQUA-78, which indicates that there would be no effect on temperatures  
19 throughout the periods evaluated relative to NAA.

20 Fall-run Flows in the Feather River at the confluence with the Sacramento River were reviewed  
21 during the February through May fall-run juvenile migration period (Appendix 11C, *CALSIM II Model*  
22 *Results utilized in the Fish Analysis*). Flows under A3\_LLT would be similar to or greater than flows  
23 under NAA throughout the February to May juvenile migration period.

24 Flows in the Feather River at the confluence with the Sacramento River were reviewed during the  
25 September through October fall-run Chinook salmon adult migration period. Flows in September  
26 under A3\_LLT would generally be up to 84% lower than flows under NAA (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). Flows during October under A3\_LLT would be similar to  
28 or greater than flows under NAA in all water year types.

#### 29 **American River**

30 Water temperatures in the American River under Alternative 3 would be the same as those under  
31 Alternative 1A, Impact AQUA-78, which indicates that there would be no effect on temperatures  
32 throughout the periods evaluated relative to NAA.

#### 33 **Fall-Run**

34 Fall-run Flows in the American River at the confluence with the Sacramento River were examined  
35 during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C,  
36 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT during February through  
37 May would be generally similar to or greater than flows under NAA, except for dry and critical water  
38 years during March (7% and 9% lower, respectively).

1 Flows in the American River at the confluence with the Sacramento River were examined during the  
2 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during September under A3\_LLTP would  
4 be up to 58% lower than flows under NAA. During October, flows under A3\_LLTP would be 40%  
5 greater than flows under NAA.

#### 6 **Stanislaus River**

7 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
8 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP would be similar to those under NAA  
10 in all months and water year types throughout the period.

11 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
12 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
13 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP would be similar to those  
14 under NAA in all months and water year types throughout the period.

15 Water temperatures in the Stanislaus River for Alternative 3 are not different from those for  
16 Alternative 1A, which indicates that there would be no effect on temperatures throughout the period  
17 evaluated, relative to NAA.

#### 18 **San Joaquin River**

19 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
20 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
21 *Analysis*). Flows under A3\_LLTP would be similar to those under NAA in all months and water year  
22 types throughout the period.

23 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
24 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
25 *in the Fish Analysis*). Flows under A3\_LLTP would be similar to those under NAA in all months and  
26 water year types throughout the period.

27 Water temperature modeling was not conducted in the San Joaquin River.

#### 28 **Mokelumne River**

29 Flows in the Mokelumne River at the Delta were examined during the February through May  
30 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
31 *the Fish Analysis*). Flows under A3\_LLTP would be similar to those under NAA in all months and water  
32 year types throughout the period.

33 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
34 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
35 *in the Fish Analysis*). Flows under A3\_LLTP would be similar to those under NAA in all months and  
36 water year types throughout the period.

37 Water temperature modeling was not conducted in the Mokelumne River.

1 **Through-Delta**

2 ***Sacramento River***

3 *Fall-Run*

4 *Juveniles*

5 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows  
6 below the north Delta intakes compared to Existing Conditions. The two intakes would replace  
7 aquatic habitat and likely attract piscivorous fish around the intake structures. Estimates of  
8 potential predation losses ranged from 0.6% (bioenergetics model, Table 11-1A-17) up to 8.8%  
9 (conservative assumption of 5% loss per intake) of fall-run annual production. Through-Delta  
10 survival by juvenile fall-run Chinook salmon under Alternative 3 was similar to NAA (Table 11-3-  
11 32).

12 **Table 11-3-32. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**  
13 **Alternative 3**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A3_LLТ	EXISTING CONDITIONS vs. A3_LLТ	NAA vs. A3_LLТ
<b>Sacramento River</b>					
Wetter Years	34.5	31.1	29.5	-5.1 (-15%)	-1.7 (-5%)
Drier Years	20.6	20.8	21.7	1.1 (5%)	0.9 (4%)
All Years	25.8	24.7	24.6	-1.2 (-5%)	-0.1 (<-1%)
<b>Mokelumne River</b>					
Wetter Years	17.2	15.7	14.7	-2.5 (-15%)	-1.1 (-7%)
Drier Years	15.6	15.9	15.4	-0.2 (-1%)	-0.6 (-4%)
All Years	16.2	15.9	15.1	-1.1 (-7%)	-0.7 (-5%)
<b>San Joaquin River</b>					
Wetter Years	19.3	20.3	20.9	1.6 (8%)	0.7 (3%)
Drier Years	10.0	9.5	10.6	0.7 (7%)	1.1 (11%)
All Years	13.5	13.6	14.5	1.0 (8%)	0.9 (7%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

14

15 *Adults*

16 River water in the Delta under Alternative 3 would be similar (<10% change) to NAA from October  
17 to December, but would be reduced by 13% in September (Table 11-3-14). Although reduction in  
18 the proportion of Sacramento River flows during September would be substantial, it would not  
19 occur during the peak migration period (October–December), and olfactory cues for fall-run adults  
20 would still be strong. The proportion of Sacramento River under Alternative 3 would still represent  
21 54–66% of Delta outflows. The reductions in percentage are less than the magnitude of change in  
22 dilution reported to cause a significant change in migration by Fretwell (1989) and, therefore, are

1 not expected to affect adult Chinook salmon migration. However, uncertainty remains with regard to  
2 adult salmon behavioral response to anticipated changes in lower Sacramento River flow  
3 percentages. This topic is discussed further in Impact AQUA-42 for Alternative 1A.

4 ***Mokelumne River***

5 *Fall-Run*

6 *Juveniles*

7 Through-Delta survival by juvenile fall-run Chinook salmon under Alternative 3 averaged across  
8 years would be 15.1% from the Mokelumne River, which is 0.7% less (5% relative decrease)  
9 compared to NAA (Table 11-2A-32). In wetter years, mean survival would be 1.1% lower (7%  
10 relative decrease) compared to NAA.

11 ***San Joaquin River***

12 *Fall-Run*

13 *Juveniles*

14 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of  
15 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.  
16 Through-Delta survival of juvenile fall-run Chinook salmon emigrating from the San Joaquin river  
17 under Alternative 3 averaged 14.5% across all years, which is 0.9% greater (7% relative increase)  
18 compared to NAA (Table 11-4-32).

19 *Adults*

20 Alternative 3 would slightly increase the proportion of San Joaquin River water in the Delta in  
21 September through December by 1.2 % (compared to NAA) (Table 11-3-14). The proportion of San  
22 Joaquin River water would be slightly increased compared NAA. Therefore migration conditions  
23 under Alternative 3 would be slightly improved.

24 *Late Fall-Run*

25 *Juveniles*

26 Through-Delta survival by emigrating juvenile late fall-run Chinook salmon under Alternative 3  
27 (A3\_LLT) would average 23% across all years, ranging from 21% in drier years to 26% in wetter  
28 years. Under Alternative 3, juvenile survival would increase slightly in drier years (0.4% greater  
29 survival, or 12% more in relative percentage) compared to NAA (Table 11-3-33).

1 **Table 11-3-33. Through-Delta Survival (%) of Emigrating Juvenile Late Fall-Run Chinook Salmon**  
2 **under Alternative 3**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A3_LLТ	EXISTING CONDITIONS vs. A3_LLТ	NAA vs. A3_LLТ
Wetter Years	28.8	27.3	27.7	-1.1 (-4%)	0.3 (1%)
Drier Years	18.8	20.2	20.6	1.9 (10%)	0.4 (2%)
All Years	22.5	22.9	23.3	0.8 (3%)	0.4 (2%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

3

4 *Adults*

5 The adult late fall–run migration is from November through March, peaking in January through  
6 March. The proportion of Sacramento River water in the Delta would be similar (<10%) to NAA  
7 throughout the migration period (Table 11-3-14).

8 Because the proportion of Sacramento River water in the Delta would not substantially change  
9 during much of the adult and juvenile fall-run Chinook salmon migration periods under Alternative  
10 3, it would not have an adverse effect on Sacramento or San Joaquin River fall-run Chinook salmon  
11 migration success through the Delta. Similarly, Alternative 3 would not have an adverse effect on  
12 adult or juvenile late fall–run Chinook salmon migration or survival.

13 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the  
14 potential to substantially reduce the availability of suitable migration habitat or substantially  
15 interfere with the movement of fish. Flows in the Feather and American rivers during one of the two  
16 months of the fall-run Chinook salmon adult migration period would be substantially lower (up to  
17 84% and up to 58%, respectively). Flows in other upstream waterways under Alternative 3 would  
18 generally be similar to or greater than those under NAA during juvenile fall- and late fall-run  
19 Chinook salmon migration periods.

20 Near-field effects of Alternative 3 NDD on fall- and late fall-run Chinook salmon related to  
21 impingement and predation associated with three new intake structures could result in negative  
22 effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high  
23 uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be  
24 directly correlated to the number of new intake structures in the river and thus the level of impacts  
25 associated with 2 new intakes would be considerably lower than those expected from having 5 new  
26 intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1%  
27 mortality) to more significant effects (~ 9% mortality above current baseline levels). CM15 would  
28 be implemented with the intent of providing localized and temporary reductions in predation  
29 pressure at the NDD. Additionally, several pre-construction surveys to better understand how to  
30 minimize losses associated with the 2 new intake structures will be implemented as part of the final  
31 NDD screen design effort. Alternative 3 also includes an Adaptive Management Program and Real-  
32 Time Operational Decision-Making Process to evaluate and make limited adjustments intended to  
33 provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time, due

1 to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of  
2 mortality expected from near-field effects at the NDD remains highly uncertain.

3 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
4 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
5 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 3  
6 predict improvements in smolt condition and survival associated with increased access to the Yolo  
7 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
8 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
9 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

10 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
11 all of these elements of BDCP operations and conservation measures to predict smolt migration  
12 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
13 migration survival under Alternative 3 would be similar to those estimated for NAA. Further  
14 refinement and testing of the DPM, along with several ongoing and planned studies related to  
15 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
16 future. These efforts are expected to improve our understanding of the relationships and  
17 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
18 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

19 Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 3 on  
20 fall-/late fall-run Chinook salmon migration conditions would be adverse.

21 This effect is a result of the specific reservoir operations and resulting flows associated with this  
22 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
23 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
24 the alternative, thereby making it a different alternative than that which has been modeled and  
25 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
26 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-78a through AQUA-  
27 78c) has the potential to reduce the severity of impact, although not necessarily to a not adverse  
28 level.

29 **CEQA Conclusion:** In general, Alternative 3 would reduce migration conditions for fall-/late fall-run  
30 Chinook salmon relative to Existing Conditions

## 31 **Upstream of the Delta**

### 32 ***Sacramento River***

33 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
34 Alternative 1A, Impact AQUA-78, which indicates that temperatures would generally not change  
35 relative to Existing Conditions during the periods evaluated.

### 36 ***Fall-Run***

37 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants were evaluated  
38 during February through May under A3\_LL1. Results indicate that flows would generally be similar  
39 to or greater than those under Existing Conditions, except in wet years during May (14% lower)  
40 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*).

1 Flows in the Sacramento River upstream of Red Bluff were evaluated during the adult fall-run  
2 Chinook salmon upstream migration period (September through October). Flows under A3\_LLT  
3 would generally be similar to or greater than those under Existing Conditions by except in wet and  
4 dry water years during September (23% and 20% lower, respectively) (Appendix 11C, *CALSIM II*  
5 *Model Results utilized in the Fish Analysis*).

#### 6 *Late Fall–Run*

7 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile late fall–run  
8 migrants (January through March). Flows under A3\_LLT during this period would be similar to or  
9 greater than flows under Existing Conditions in all months and water year types (Appendix 11C,  
10 *CALSIM II Model Results utilized in the Fish Analysis*).

11 Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall–run  
12 Chinook salmon upstream migration period (December through February). Flows under A3\_LLT  
13 during this period would be similar to or greater than flows under Existing Conditions in all months  
14 and water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 15 **Clear Creek**

16 Water temperature modeling was not conducted in Clear Creek.

#### 17 *Fall-Run*

18 Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon  
19 upstream migration period (February through May) under A3\_LLT would be similar to or greater  
20 than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*  
21 *utilized in the Fish Analysis*).

22 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
23 upstream migration period (September through October) under A3\_LLT would generally be similar  
24 to or greater than those under Existing Conditions except in critical years during September (37%  
25 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

#### 26 **Feather River**

27 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
28 Alternative 1A, Impact AQUA-78, which indicates that there would be no differences in  
29 temperatures during the periods evaluated, compared to Existing Conditions.

#### 30 *Fall-Run*

31 Flows in the Feather River at the confluence with the Sacramento River were evaluated during the  
32 fall-run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results*  
33 *utilized in the Fish Analysis*). Flows under A3\_LLT would generally be similar to or greater than flows  
34 under Existing Conditions during February through April, except in below normal years during  
35 March (12% lower) and in wet years during May (24% lower).

36 Flows in the Feather River at the confluence with the Sacramento River were evaluated during the  
37 September through October fall-run Chinook salmon adult migration period. Flows during  
38 September under A3\_LLT would generally be lower than flows under Existing Conditions by up to  
39 24% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Although flow reductions

1 would be moderate, they would occur in the majority of years, including dry and below normal years  
2 when flow reductions have a larger effect on Chinook salmon. Flows during October under A3\_LLT  
3 would generally be similar to or greater than flows under Existing Conditions except in below  
4 normal water years (6% lower).

#### 5 **American River**

6 Water temperatures in the American River under Alternative 3 would be the same as those under  
7 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher relative to  
8 Existing Conditions during substantial portions of the periods evaluated.

#### 9 *Fall-Run*

10 Flows in the American River at the confluence with the Sacramento River were examined during the  
11 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT during February through April would  
13 generally be similar to or greater than flows under Existing Conditions, except for critical years  
14 during February and March (14% and 12% lower, respectively) and in above normal years during  
15 April (8% lower). Flows under A3\_LLT during May would generally be lower than flows under  
16 Existing Conditions by up to 27%.

17 Flows in the American River at the confluence with the Sacramento River were examined during the  
18 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
19 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT during September would  
20 be 44% to 55% lower than flows under Existing Conditions. Flows under A3\_LLT during October  
21 would be 9% to 30% greater than those under Existing Conditions.

#### 22 **Stanislaus River**

#### 23 *Fall-Run*

24 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
25 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT throughout this period would  
27 generally be lower than Existing Conditions (up to 36% lower), except for March in wet water years  
28 (7% greater).

29 Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
30 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher than under  
31 Existing Conditions during substantial portions of the juvenile migration period evaluated.

32 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
33 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
34 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be similar  
35 to flows under Existing Conditions during September, except in wet and above normal years (17%  
36 and 6% lower, respectively). During October, flows would be 6% to 11% lower depending on water  
37 year type.

38 Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
39 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher than under  
40 Existing Conditions during September, but not October.

1 **San Joaquin River**

2 *Fall-Run*

3 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
4 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
5 *Analysis*). Flows under A3\_LLТ would be similar to Existing Conditions but with 8% to 13% lower  
6 flows in two water years during February, and would be lower than Existing Conditions by up to  
7 16% during March, April, and May.

8 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
9 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
10 *in the Fish Analysis*). Flows under A3\_LLТ would be lower than Existing Conditions by up to 11%  
11 during both months.

12 Water temperature modeling was not conducted in the San Joaquin River.

13 **Mokelumne River**

14 *Fall-Run*

15 Flows in the Mokelumne River at the Delta were examined during the February through May  
16 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
17 *the Fish Analysis*). Flows under A3\_LLТ would be similar to or greater than those under Existing  
18 Conditions during February and March, but up to 18% lower than flows under Existing Conditions  
19 during April and May.

20 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
21 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
22 *in the Fish Analysis*). Flows under A3\_LLТ would be up to 29% lower than those under Existing  
23 Conditions depending on the month and water year type.

24 Water temperature modeling was not conducted in the Mokelumne River.

25 **Through-Delta**

26 Through-Delta survival of juvenile fall-run Chinook salmon under Alternative 3 compared to  
27 Existing Conditions would be slightly increased in drier years (5% relative increase) and decreased  
28 in wetter years (15% relative decrease) from the Sacramento River, decreased from the Mokelumne  
29 River, especially in wetter years (15% relative decrease); and increased for juveniles from the San  
30 Joaquin River (8% relative increase) (Table 11-3-32).

31 Patterns in adult attraction flow would be similar (within 3% to 6%) for Sacramento River adults,  
32 and increased slightly for San Joaquin River adults compared to Existing Conditions (Table 11-3-14).

33 **Summary of CEQA Conclusion**

34 Collectively, the results indicate that Alternative 3 would be significant because the alternative  
35 would substantially reduce the fall-/late fall-run Chinook salmon migration habitat and substantially  
36 interfere with the movement of fish. There would be flow reductions under Alternative 3 relative to  
37 Existing Conditions during substantial portions of the migration periods evaluated in the Feather,  
38 American, Stanislaus, and San Joaquin Rivers. Further, there would be water temperature increases  
39 during substantial portions of the periods evaluated in the American and Stanislaus Rivers. There

1 would be negligible effects of Alternative 3 on juvenile and adult fall-/late fall-run Chinook salmon  
2 migration through the Delta.

3 Although the CEQA analyses indicate some significant effects of water operations on juvenile fall-  
4 /late fall-run Chinook salmon migrations, the implementation of the mitigation measures listed  
5 below has the potential to reduce the severity of the impact, although not necessarily to a less-than-  
6 significant level. These mitigation measures would provide an adaptive management process, that  
7 may be conducted as a part of the Adaptive Management and Monitoring Program required by the  
8 BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate  
9 minimization measures.

10 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**  
11 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**  
12 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

13 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for  
14 fall/late fall-run Chinook salmon.

15 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**  
16 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**  
17 **of CM1**

18 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for  
19 fall/late fall-run Chinook salmon.

20 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**  
21 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**  
22 **Migration Conditions Consistent with CM1**

23 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for  
24 fall/late fall-run Chinook salmon.

25 **Restoration Measures (CM2, CM4–CM7, and CM10)**

26 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
27 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
28 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
29 restoration measures described for fall- and late fall-run Chinook salmon under Alternative 1A  
30 (Impact AQUA-79 through AQUA-81) also appropriately characterize effects under Alternative 3.

31 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

32 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**  
33 **(Fall-/Late Fall-Run ESU)**

34 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**  
35 **Salmon (Fall-/Late Fall-Run ESU)**

36 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**  
37 **Run ESU)**

1 **NEPA Effects:** All of these effects have been determined to result in no adverse effects on fall-  
2 run/late fall-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.  
3 Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with  
4 respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of  
5 methylmercury on fall- and late fall-run Chinook salmon are uncertain.

6 **CEQA Conclusion:** All of these effects would be considered less than significant for CEQA purposes,  
7 for the reasons identified for Alternative 1A.

#### 8 **Other Conservation Measures (CM12–CM19 and CM21)**

9 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
10 differences in other conservation-related fish effects are anticipated anywhere in the affected  
11 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
12 effects of other conservation measures described for fall- and late fall-run Chinook salmon under  
13 Alternative 1A (Impact AQUA-82 through AQUA-90) also appropriately characterize effects under  
14 Alternative 3.

15 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

#### 16 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall- 17 Run ESU) (CM12)**

#### 18 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon 19 (Fall-/Late Fall-Run ESU) (CM13)**

#### 20 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall- 21 /Late Fall-Run ESU) (CM14)**

#### 22 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon 23 (Fall-/Late Fall-Run ESU) (CM15)**

#### 24 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall- 25 Run ESU) (CM16)**

#### 26 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run 27 ESU) (CM17)**

#### 28 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run 29 ESU) (CM18)**

#### 30 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late 31 Fall-Run ESU) (CM19)**

#### 32 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon 33 (Fall-/Late Fall-Run ESU) (CM21)**

34 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
35 adverse effect, or beneficial effects on fall- and late fall-run Chinook salmon for NEPA purposes, for  
36 the reasons identified for Alternative 1A.

1 **CEQA Conclusions:** The nine impact mechanisms would be considered to range from no impact, to  
2 less than significant, or beneficial on fall- and late fall-run Chinook salmon, for the reasons identified  
3 for Alternative 1A, and no mitigation is required.

## 4 **Steelhead**

### 5 **Construction and Maintenance of CM1**

#### 6 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

7 The potential effects of construction of water conveyance facilities steelhead under Alternative 3  
8 would be similar to those described for Alternative 1A (see Impact AQUA-91) except that Alternative  
9 3 would include two intakes compared to five intakes under Alternative 1A, so the effects would be  
10 proportionally less under this alternative. This would convert about 4,450 lineal feet of existing  
11 shoreline habitat into intake facility structures and would require about 10.2 acres of dredge and  
12 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
13 would require 27.3 acres of dredging. The effects related to temporary increases in turbidity,  
14 accidental spills, underwater noise, in-water work activities, and disturbance of contaminated  
15 sediments would be similar to Alternative 1A and the same environmental commitments and  
16 mitigation measures (described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
17 *Environmental Commitments*) would be available to avoid and minimize potential effects.

18 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-91, environmental commitments and  
19 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
20 not be adverse for steelhead.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-91, the impact of the construction of  
22 the water conveyance facilities on steelhead would be less than significant except for construction  
23 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
24 because only two intakes would be constructed rather than five. Implementation of Mitigation  
25 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
26 significant.

#### 27 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 28 **of Pile Driving and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
30 Alternative 1A.

#### 31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
34 Alternative 1A.

#### 35 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

36 **NEPA Effects:** The potential impacts of the maintenance of water conveyance facilities under  
37 Alternative 3 would be similar to those described for Alternative 1A except that only two intakes  
38 would need to be maintained under Alternative 3 instead of five under Alternative 1A (see Impact

1 AQUA-92). As concluded in Alternative 1A, Impact AQUA-92, the effect would not be adverse for  
2 steelhead.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance  
4 of water conveyance facilities on steelhead would be less than significant and no mitigation would  
5 be required.

## 6 **Water Operations of CM1**

### 7 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

#### 8 ***Water Exports from SWP/CVP South Delta Facilities***

9 Alternative 3 would reduce entrainment losses of juvenile steelhead at the SWP/CVP south Delta  
10 facilities, similar to Alternative 1A (Impact AQUA-93). Entrainment, estimated as salvage density,  
11 would be highest in above normal and below normal water year types, but would decrease 20–22%  
12 (~2,000 fish; Table 11-3-34) across all water year types compared to NAA. Under Alternative 3,  
13 entrainment in above and below normal water years would decrease 17–22% (~1,900–2,600 fish)  
14 compared to NAA. The greatest relative reductions would occur in wet years (~1,800 fish; decrease  
15 27–28%). This effect is not adverse and may be beneficial to steelhead.

#### 16 ***Water Exports from SWP/CVP North Delta Intake Facilities***

17 The effect would be similar in type to Alternative 1A (with five intakes), but the degree is less  
18 because Alternative 3 has only two intakes. Therefore, under Alternative 3 there would be a 60%  
19 reduction in impingement and predation risk associated with the north Delta facilities relative to  
20 Alternative 1A. The conclusions are the same as for Alternative 1A, Impact AQUA-93, and the effect  
21 would not be adverse.

#### 22 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

23 The effects and conclusion are the same as for Impact AQUA-93 for Alternative 1A. Entrainment and  
24 impingement effects on juvenile steelhead would be minimal for Alternative 3 because intakes  
25 would have state-of-the-art screens installed. Overall, the effect on steelhead under Alternative 3  
26 would not be adverse and may provide a small benefit to the species because entrainment would be  
27 reduced, especially at the south Delta facilities.

#### 28 ***Predation Associated with Entrainment***

29 Steelhead predation loss at the south Delta facilities is assumed to be proportional to entrainment  
30 loss. Average pre-screen predation loss for steelhead entrained at the Clifton Court Forebay is about  
31 80% (Clark et al. 2009) while predation loss for fish entrained at the CVP is assumed to be 15%.  
32 Predation loss at the south Delta for steelhead would be reduced by 20–22% compared to NAA. The  
33 effects and conclusion for the risk of predation associated with the NPB structures would be the  
34 same as described for Alternative 1A (Impact AQUA-93).

35 Predation at the north Delta would be increased due to the construction of the proposed SWP/CVP  
36 water export facilities on the Sacramento River. It is assumed that per capita steelhead predation  
37 losses would be similar to those predicted for spring-run Chinook salmon, although slightly reduced  
38 because of the larger size of steelhead outmigrants. Bioenergetics modeling with a median predator

1 density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a predation loss of  
2 about 0.6% of the juvenile spring-run juvenile population (Table 11-3-12).

3 **NEPA Effects:** The overall predation and entrainment losses would likely have a very minor impact  
4 on the overall steelhead population, Therefore, the effect under Alternative 3 would not be adverse.

5 **CEQA Conclusion:** Entrainment losses of juvenile steelhead would be less under Alternative 3  
6 compared to Existing Conditions (Table 11-3-34). Impacts of water operations on entrainment of  
7 steelhead would be less than significant and may be beneficial to the species because of the  
8 reduction in entrainment loss and mortality. No mitigation would be required.

9 **Table 11-3-34. Juvenile Steelhead Annual Entrainment Index<sup>a</sup> at the SWP and CVP Salvage**  
10 **Facilities—Differences between Model Scenarios for Alternative 3**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-1,644 (-26%)	-1,736 (-27%)
Above Normal	-2,117 (-16%)	-2,461 (-18%)
Below Normal	-2,586 (-22%)	-1,856 (-17%)
Dry	-267 (-4%)	324 (5%)
Critical	-678 (-12%)	-327 (-6%)
All Years	-1,919 (-21%)	-1,777 (-20%)

<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.

11  
12 The impact and conclusion for predation associated with entrainment would be the same as  
13 described above as predation loss would be reduced at the south Delta (21% compared to Existing  
14 Conditions), but increased slightly at the north Delta intakes. There would likely be a minor increase  
15 in predation loss under Alternative 3, but the population level effect would likely be small (<1% of  
16 the population). Therefore, the impact would be less than significant and no mitigation would be  
17 required.

18 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
19 **Steelhead**

20 In general, the effects of Alternative 3 on steelhead spawning conditions would be negligible relative  
21 to NAA.

22 **Sacramento River**

23 Water temperatures in the Sacramento River for Alternative 3 are not different from those for  
24 Alternative 1A, Impact AQUA-94, which indicates that temperatures would be similar to those under  
25 NAA.

26 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where  
27 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning  
28 and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized*  
29 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg  
30 incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under A3\_LLT

1 throughout the period would generally be similar to those under NAA except during January during  
2 critical water years (8% lower flow).

3 SacEFT predicts that there would be a 6% decrease (3% on an absolute scale) in the percentage of  
4 years with good spawning availability, measured as weighted usable area, under A3\_LLT relative to  
5 NAA (Table 11-3-35). SacEFT predicts that there would be negligible (<5%) differences between  
6 NAA and A3\_LLT in the percentage of years with good (lower) redd scour risk, good (lower) egg  
7 incubation conditions, and good (lower) redd dewatering risk. These results indicate that there  
8 would be no effect of Alternative 3 on spawning habitat quantity, redd scour risk or temperature-  
9 related egg incubation conditions.

10 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
11 Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude  
12 and frequency of water temperatures potentially affecting the quantity and quality of spawning and  
13 incubation habitat under Alternative 1A and baseline conditions would be comparable and would  
14 therefore not affect long-term habitat conditions relative to baseline conditions.

15 Overall, these results indicate that the effects of Alternative 3 on steelhead spawning and egg  
16 incubation habitat in the Sacramento River would be negligible.

17 **Table 11-3-35. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
18 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-1 (-2%)	2 (4%)
Juvenile Rearing WUA	-3 (-7%)	-7 (-16%)
Juvenile Stranding Risk	-17 (-50%)	-3 (-15%)

WUA = Weighted Usable Area.

19

20 **Clear Creek**

21 No water temperature modeling was conducted in Clear Creek.

22 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period  
23 (January through April). Flows under A3\_LLT would generally be similar to flows under NAA  
24 throughout the period, except in critical years during February (6% lower), below normal years  
25 during March (6% lower), and critical years during January (7% higher) (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*).

27 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest  
28 monthly flow reduction would be identical between NAA and A3\_LLT for all water year types except  
29 for substantial flow reductions in some critical years (100% reduction, to 0 cfs) (Table 11-3-36),  
30 which would pose substantial redd dewatering risk for that time-frame.

31 Overall, these results indicate that the effects of Alternative 3 on steelhead spawning and egg  
32 incubation habitat in Clear Creek would be negligible except in some critical years.

1 **Table 11-3-36. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**  
 2 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**  
 3 **Incubation Period<sup>a</sup>**

Water Year Type	A3_LLT vs. EXISTING CONDITIONS	A3_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	-100 (NA)	-100 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 ***Feather River***

6 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and  
 7 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation  
 8 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
 9 Flows in the low-flow channel under A3\_LLT would not differ from NAA because minimum Feather  
 10 River flows are included in the FERC settlement agreement and would be met for all model  
 11 scenarios (California Department of Water Resources 2006). Flows under A3\_LLT at Thermalito  
 12 Afterbay would generally be much greater than flows under NAA (5% to 70%), except for the  
 13 occurrence of a decrease in critical years during January (20% lower).

14 Oroville Reservoir storage volume at the end of September and end of May influences flows  
 15 downstream of the dam during the steelhead spawning and egg incubation period. Storage volume  
 16 at the end of September under A3\_LLT would be up to 32% greater than storage under NAA  
 17 depending on water year type (Table 11-3-20). May Oroville storage under A3\_LLT would be similar  
 18 to storage under NAA (Table 11-3-21).

19 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
 20 Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that water temperatures would  
 21 be comparable and would therefore not affect long-term habitat conditions relative to NAA.

22 Overall, these results indicate that the effects of Alternative 3 on steelhead spawning and egg  
 23 incubation habitat in the Feather River would be beneficial.

24 ***American River***

25 Flows in the American River at the confluence with the Sacramento River were examined for the  
 26 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
 27 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be similar to flows  
 28 under NAA during the period except in dry and critical years during March (7% and 9% lower,  
 29 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Water temperatures in the American River under Alternative 3 would be the same as those under  
2 Alternative 1A, Impact AQUA-94, which indicates that there would be no effects of Alternative 3 on  
3 temperatures during the periods evaluated.

4 Overall, these results indicate that the effects of Alternative 3 on steelhead spawning and egg  
5 incubation habitat in the American River would be negligible.

#### 6 ***Stanislaus River***

7 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
8 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under A3\_LL1 throughout this period would  
10 generally be identical to flows under NAA.

11 Water temperatures in the American River under Alternative 3 would be the same as those under  
12 Alternative 1A, Impact AQUA-94, which indicates that there would be no effects on temperatures  
13 during the periods evaluated, relative to NAA.

#### 14 ***San Joaquin River***

15 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 16 ***Mokelumne River***

17 Flows in the Mokelumne River at the Delta were examined during the January through April  
18 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
19 *Fish Analysis*). Flows under A3\_LL1 throughout this period would generally be identical to flows  
20 under NAA.

21 Water temperature modeling was not conducted in the Mokelumne River.

22 ***NEPA Effects:*** Collectively, these results indicate that the effect of Alternative 3 would not be  
23 adverse because it would not substantially reduce suitable spawning or egg incubation habitat or  
24 substantially reduce the number of fish as a result of egg mortality. Project-related effects on  
25 steelhead egg incubation and spawning conditions based on mean monthly flow consist primarily of  
26 negligible effects (<5%), small decreases in mean monthly flow (to -12%) that would not adversely  
27 affect steelhead spawning conditions in any of the locations analyzed. There would be beneficial  
28 effects from substantial increases in mean monthly flow for some months and water year types in  
29 the Feather River (primarily of increases in mean monthly flow ranging from 5% to 70% throughout  
30 the spawning period). SacEFT predicts there would be no effects of Alternative 3 on spawning and  
31 egg incubation habitat in the Sacramento River.

32 ***CEQA Conclusion:*** In general, Alternative 3 would not reduce the quantity and quality of steelhead  
33 spawning habitat relative to the Existing Conditions.

#### 34 ***Sacramento River***

35 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where  
36 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning  
37 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*  
38 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg  
39 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows

1 under A3\_LLT would generally be similar to flows under Existing Conditions in March and April, and  
2 higher than flows under Existing Conditions in January and February with some exceptions.  
3 Upstream of Red Bluff Diversion Dam, flows would generally be similar between Existing Conditions  
4 and A3\_LLT throughout the period with somewhat better conditions in January.

5 SacEFT predicts no differences in spawning habitat and egg incubation and negligible changes  
6 (<5%) in redd scour and dewatering risk between Existing Conditions and Alternative 3 (Table 11-  
7 3-35).

8 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
9 Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that water temperatures under  
10 NAA and Alternative 1A would be comparable and would therefore not affect long-term habitat  
11 conditions relative to NAA.

12 Overall, these results indicate that the effects of Alternative 3 on steelhead spawning and egg  
13 incubation habitat in the Sacramento River would be negligible

#### 14 **Clear Creek**

15 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period  
16 (January through April). Flows under A3\_LLT would be similar to or greater than flows under  
17 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*  
18 *Fish Analysis*).

19 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest  
20 monthly flow reduction would be identical between Existing Conditions and A3\_LLT for all water  
21 year types except wet, in which the greatest reduction would be 38% lower (worse) under A3\_LLT  
22 than under Existing Conditions (Table 11-3-36).

23 No water temperature modeling was conducted in Clear Creek.

24 Overall, these results indicate that the effects of A3\_LLT on steelhead spawning and egg incubation  
25 habitat in Clear Creek would be negligible.

#### 26 **Feather River**

27 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and  
28 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation  
29 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
30 Flows in the low-flow channel under A3\_LLT would not differ from Existing Conditions because  
31 minimum Feather River flows are included in the FERC settlement agreement and would be met for  
32 all model scenarios (California Department of Water Resources 2006). Flows under A3\_LLT at  
33 Thermalito Afterbay would generally be greater than flows under Existing Conditions, except in  
34 above and below normal water years during January (6% and 36% lower, respectively), below  
35 normal years during February and March (22% and 33% lower, respectively), and wet water years  
36 during April (30% lower).

37 Oroville Reservoir storage volume at the end of September and end of May influences flows  
38 downstream of the dam during the steelhead spawning and egg incubation period. Oroville  
39 Reservoir storage volume at the end of September would be 2% to 20% lower under A3\_LLT  
40 relative to Existing Conditions depending on water year type (Table 11-3-20). May Oroville storage

1 volume under A3\_LLT would be lower than Existing Conditions by 2% to 16% depending on water  
2 year type (Table 11-3-21).

3 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
4 Alternative 1A, Impact AQUA-94 which indicates that there would be substantial increases in  
5 temperatures relative to Existing Conditions during portions of the periods evaluated.

6 Overall, these results indicate that there would be negligible effects of Alternative 3 on mean  
7 monthly flows in the low-flow channel, but that flows in the high-flow channel would be  
8 substantially lower in some water year types and months. Alternative 3 would increase exposure of  
9 spawning steelhead and their eggs to critical water temperatures, in some water years, a result of  
10 reduced coldwater pool availability in Oroville Reservoir.

### 11 ***American River***

12 Flows in the American River at the confluence with the Sacramento River were examined for the  
13 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
14 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be similar to or  
15 greater than flows under Existing Conditions in January through April except that they would be  
16 substantially lower in dry and critical years in January, critical years in February and March and  
17 above normal years in April. Overall, these results indicate that the effects of Alternative 3 on  
18 steelhead spawning and egg incubation habitat in the American River would be negligible to minor.

19 Water temperatures in the American River under Alternative 3 would be the same as those under  
20 Alternative 1A, which indicates that there would be substantial increases in temperatures during the  
21 periods evaluated, compared to Existing Conditions.

### 22 ***Stanislaus River***

23 Flows in the Stanislaus River for Alternative 3 are substantially below those under Existing  
24 Conditions in all months.

25 Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
26 Alternative 1A, Impact AQUA-94, which indicates that temperatures would be greater than those  
27 under Existing Conditions during the entire period evaluated.

### 28 ***San Joaquin River***

29 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

### 30 ***Mokelumne River***

31 Flows in the Mokelumne River for Alternative 3 would be similar to or higher than under Existing  
32 Conditions in January and February (up to 18% higher), similar to Existing Conditions in March  
33 except for being lower in dry years (8% lower), and substantially lower in most water year types in  
34 April (up to 14%).

35 Water temperature modeling was not conducted in the Mokelumne River.

### 36 **Summary of CEQA Conclusion**

37 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between  
38 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the

1 alternative could substantially reduce suitable spawning habitat and substantially reduce the  
2 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Flows  
3 under Alternative 3 would be similar to flows under Existing Conditions in all rivers except the  
4 Stanislaus River, Mokelumne River and in the Feather River high flow channel. However, only a  
5 small number of steelhead spawn in this reach of the Feather River (Cavallo et al. 2003). The  
6 majority of steelhead spawning occurs in Hatchery Ditch and the low-flow channel in the general  
7 vicinity of the Feather River Hatchery. In addition, there would be substantial negative effects on  
8 water temperatures in the Feather, American, and Stanislaus Rivers.

9 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
10 change, future water demands, and implementation of the alternative. The analysis described above  
11 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
12 alternative from those of sea level rise, climate change and future water demands using the model  
13 simulation results presented in this chapter. However, the increment of change attributable to the  
14 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
15 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
16 implementation period, which does include future sea level rise, climate change, and water  
17 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
18 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
19 effect of the alternative from those of sea level rise, climate change, and water demands.

20 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
21 term implementation period and Alternative 3 indicates that flows in the locations and during the  
22 months analyzed above would generally be similar between Existing Conditions during the LLT and  
23 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
24 found above would generally be due to climate change, sea level rise, and future demand, and not  
25 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
26 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
27 result in a significant impact on spawning habitat for steelhead. This impact is found to be less than  
28 significant and no mitigation is required.

### 29 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

30 In general, Alternative 3 would reduce the quantity and quality of steelhead rearing habitat relative  
31 to NAA.

#### 32 ***Sacramento River***

33 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream  
34 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in  
35 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the  
36 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to  
37 upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
38 Analysis*). Flows during September, October, and between December and July under A3\_LLTP would  
39 generally be similar to or greater than those under NAA. Flows during August and November would  
40 generally be lower under A3\_LLTP than under NAA.

41 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions  
42 under A3\_LLTP would be 16% lower (7% on an absolute scale) than that under NAA (Table 11-3-35).  
43 Also, the percentage of years with good (lower) juvenile stranding risk conditions under A3\_LLTP

would be 15% lower (3% on an absolute scale) than under NAA. These results indicate that Alternative 3 would cause a small decrease in rearing habitat availability in the Sacramento River.

Water temperatures in the Sacramento River under Alternative 3 would be the same as those under Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of rearing habitat under NAA and Alternative 1A would be comparable and would therefore not affect long-term habitat conditions relative to NAA.

**Clear Creek**

No water temperature modeling was conducted in Clear Creek.

Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under A3\_LLT would generally be similar to or greater than flows under NAA, except for critical years in February, October and December and above normal years in March in which flows would be 6% to 9% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Water temperatures were not modeled in Clear Creek.

It was assumed that habitat for juvenile steelhead rearing would be constrained by the month having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows increase, and therefore the lowest monthly instream flow was used as an index of habitat constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing habitat, based on minimum instream flows, is comparable for Alternative 3 relative to NAA in wet, above normal, below normal and dry water year types (Table 11-3-37). Minimum flows would be 10% higher in critical years.

Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-1A-4). The current Clear Creek management regime uses flows slightly lower than those recommended by Denton. Results from a new IFIM study on Clear Creek are currently being analyzed. Depending on results of this study the flow regime could be adjusted in the future. We expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek. No change in effect on steelhead in Clear Creek is anticipated.

**Table 11-3-37. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	A3_LLT vs. EXISTING CONDITIONS	A3_LLT vs. NAA
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	-7 (-8%)	7 (10%)

Note: Minimum flows occurred between October and March.

**Feather River**

Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing

1 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is  
2 the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al.  
3 2003). Relatively constant flows in the low flow channel throughout the year under A3\_LLTP would  
4 not differ from those under NAA. In the high flow channel, flows under A3\_LLTP would be mostly  
5 lower (up to 84%) during July through September and in critical water years during January and  
6 mostly greater (up to 72%) than flows under Existing Conditions in other months.

7 May Oroville storage under A3\_LLTP would be similar to storage under NAA (Table 11-3-21).  
8 September Oroville storage volume would be greater, up to 28% higher than under NAA depending  
9 on water year type (Table 11-3-20).

10 Water temperatures in the Feather River low-flow and high-flow channel under Alternative 3 would  
11 be the same as those under Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that  
12 water temperatures potentially affecting the quantity and quality of rearing habitat under NAA and  
13 Alternative 1A would be comparable and would therefore not affect long-term habitat conditions  
14 relative to NAA.

#### 15 **American River**

16 Flows in the American River at the confluence with the Sacramento River were examined for the  
17 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
18 *Analysis*). Flows under A3\_LLTP would generally be similar to flows under NAA during January  
19 through April and October through December, greater than flows under NAA during May, June and  
20 October, and lower than flows under NAA during July through September.

21 Water temperatures in the American River under Alternative 3 would be the same as those under  
22 Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that the predicted magnitude  
23 and frequency of water temperatures potentially affecting the quantity and quality of rearing habitat  
24 under NAA and Alternative 1A would be comparable and would therefore not affect long-term  
25 habitat conditions relative to NAA.

#### 26 **Stanislaus River**

27 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
28 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
29 *Analysis*). Flows under A3\_LLTP would be similar to flows under NAA for the entire year except for  
30 increases in dry and critical water years during June.

31 Water temperatures in the American River under Alternative 3 would be the same as those under  
32 Alternative 1A, Impact AQUA-95, which indicates that there would be no effect, relative to NAA,  
33 during the period evaluated.

#### 34 **San Joaquin River**

35 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
36 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP  
37 would be similar to flows under NAA throughout the period.

38 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 Flows in the Mokelumne River for Alternative 3 were examined for the year-round steelhead rearing  
3 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) and the flows are not  
4 different from those under NAA.

5 **NEPA Effects:** Collectively, these results indicate the effect would be adverse because it has the  
6 potential to substantially reduce rearing habitat for larval and juvenile steelhead. SacEFT predicts  
7 that there would be a reduction in rearing habitat availability in the Sacramento River. Further,  
8 there would be reductions during July through September in instream flows in the Sacramento,  
9 Feather, and American Rivers under Alternative 3 relative to the NEPA baseline, which would  
10 reduce the quality and quantity of rearing habitat for larval and juvenile steelhead. There would be  
11 no effects on temperatures in the Sacramento, Feather, American, or Stanislaus Rivers. There would  
12 be no effects on flows in the Stanislaus, San Joaquin, or Mokelumne Rivers. There would be  
13 beneficial effects from increases in mean monthly flow for some months and water year types in  
14 Clear Creek, the Feather River, and the American River. However, these would not offset the  
15 negative effects of more persistent and/or more critically timed reductions in flow (e.g., during  
16 summer months and/or in drier water year types). This effect is a result of the specific reservoir  
17 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing  
18 reservoir operations in order to alter the flows) to the extent necessary to reduce this effect to a  
19 level that is not adverse would fundamentally change the alternative, thereby making it a different  
20 alternative than that which has been modeled and analyzed. As a result, this would be an  
21 unavoidable adverse effect because there is no feasible mitigation available. Even so, proposed  
22 mitigation (Mitigation Measure AQUA-95a through AQUA-95c) has the potential to reduce the  
23 severity of impact, although not necessarily to a not adverse level.

24 **CEQA Conclusion:** In general, Alternative 3 would not affect the quantity and quality of steelhead  
25 rearing habitat relative to the Existing Conditions.

26 **Sacramento River**

27 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and  
28 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM  
29 II Model Results utilized in the Fish Analysis*). Flows during October and between December and June  
30 under A3\_LLT would generally be similar to or greater than those under Existing Conditions. Flows  
31 during August, September and November would generally be lower under A3\_LLT than under  
32 Existing Conditions.

33 SacEFT predicts that there would be a 7% decrease in the percentage of years with good rearing  
34 availability, measured as weighted usable area, under A3\_LLT relative to Existing Conditions (Table  
35 11-3-35). SacEFT predicts that there would be a substantial reduction (-50%) in the number of  
36 years with good (lower) juvenile stranding risk under A3\_LLT relative Existing Conditions.

37 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
38 Alternative 1A, Impact AQUA-95, which indicates that temperatures would generally not be affected  
39 by Alternative 3 relative to Existing Conditions.

40 **Clear Creek**

41 Flows in Clear Creek during the year-round rearing period under A3\_LLT would generally be similar  
42 to or greater than flows under Existing Conditions, except for critical years in August and September

1 in which flows would be 17% to 37% lower (Appendix 11C, *CALSIM II Model Results utilized in the*  
2 *Fish Analysis*).

3 No temperature modeling was conducted in Clear Creek.

4 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and  
5 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile  
6 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream  
7 flows affecting juvenile rearing habitat are shown in Table 11-3-37. Results indicate that Alternative  
8 3 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to  
9 Existing Conditions in wet, above normal, below normal and dry water years. Minimum flows would  
10 be 8% lower in critical years (reduction from 50 cfs to 43 cfs).

11 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-  
12 1A-4). The current Clear Creek management regime uses flows slightly lower than those  
13 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being  
14 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We  
15 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.  
16 No change in effect on steelhead in Clear Creek is anticipated.

#### 17 **Feather River**

18 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
19 Alternative 1A, Impact AQUA-95 which indicate that temperatures would increase relative to  
20 Existing Conditions during the year-round period.

21 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and  
22 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 3 relative to Existing  
23 Conditions in the low-flow channel during the year-round steelhead juvenile rearing period  
24 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at  
25 Thermalito Afterbay), flows under A3\_LLТ would be lower (up to 51%) during July and August and  
26 some water year types in November, and mostly greater (up to 149%) than flows under Existing  
27 Conditions in other months.

28 May Oroville storage volume under A3\_LLТ would be lower than Existing Conditions by 2% to 16%  
29 depending on water year type (Table 11-3-21). September Oroville storage volume would be 2% to  
30 20% lower under A3\_LLТ relative to Existing Conditions depending on water year type (Table 11-3-  
31 20).

#### 32 **American River**

33 Water temperatures in the American River under Alternative 3 would be the same as those under  
34 Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase relative to  
35 Existing Conditions during the year-round period.

36 Flows in the American River at the confluence with the Sacramento River were examined for the  
37 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
38 *Analysis*). Flows under A3\_LLТ would be up to 28% greater than to flows under Existing Conditions  
39 during February, March, and October, similar to flows under Existing Conditions during April, and  
40 up to 58% lower than flows under Existing Conditions during the remaining eight months of the  
41 year.

1       **Stanislaus River**

2       Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
3       year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4       *Analysis*). Flows under A3\_LLTP would be similar to flows under Existing Conditions during August,  
5       September, and November and up to 26% lower than flows under Existing Conditions during the  
6       remaining 9 months.

7       Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
8       Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase relative to  
9       Existing Conditions during most of the year-round period.

10       **San Joaquin River**

11       Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
12       period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP  
13       would be up to 6% higher than Existing Conditions during January, generally similar to Existing  
14       Conditions during February except for being lower in two water years, lower in most water years  
15       than Existing Conditions during March through October (up to 38% lower), and similar to Existing  
16       Conditions during November and December.

17       Water temperature modeling was not conducted in the San Joaquin River.

18       **Mokelumne River**

19       Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
20       period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP  
21       would be similar to flows under Existing Conditions during January through March, up to 15%  
22       greater than flows under Existing Conditions during December, and up to 52% lower than flows  
23       under Existing Conditions during the remaining 8 months.

24       Water temperature modeling was not conducted in the Mokelumne River.

25       **Summary of CEQA Conclusion**

26       Collectively, these results indicate that the impact on rearing habitat for steelhead would be  
27       significant because there would be the potential to substantially reduce rearing habitat and  
28       substantially reduce the number of fish as a result of mortality. Alternative 3 would cause reductions  
29       in mean monthly flow (to -58%) for much of the rearing period in most locations analyzed that  
30       would affect the quantity and quality of juvenile rearing habitat and would contribute to reduced  
31       survival and increased stress. Alternative 3 would have negative effects on water temperature  
32       conditions during the year-round steelhead rearing period in the Feather, American, and Stanislaus  
33       Rivers relative to Existing Conditions, but not in the Sacramento River. This impact is a result of the  
34       specific reservoir operations and resulting flows associated with this alternative. Applying  
35       mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
36       reduce this impact to a less-than-significant level would fundamentally change the alternative,  
37       thereby making it a different alternative than that which has been modeled and analyzed. As a  
38       result, this impact is significant and unavoidable because there is no feasible mitigation available.  
39       Even so, proposed below is mitigation that has the potential to reduce the severity of impact though  
40       not necessarily to a less-than-significant level.

1       **Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional**  
2       **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**  
3       **Reduce Impacts to Rearing Habitat.**

4       Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
5       significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the  
6       best available scientific information at the time and may prove to have been overstated. Upon  
7       the commencement of operations of CM1 and continuing through the life of the permit, the  
8       BDCP proponents will monitor effects on rearing habitat in order to determine whether such  
9       effects would be as extensive as concluded at the time of preparation of this document and to  
10      determine any potentially feasible means of reducing the severity of such effects. This mitigation  
11      measure requires a series of actions to accomplish these purposes, consistent with the  
12      operational framework for Alternative 3.

13      The development and implementation of any mitigation actions shall be focused on those  
14      incremental effects attributable to implementation of Alternative 3 operations only.  
15      Development of mitigation actions for the incremental impact on spawning habitat attributable  
16      to climate change/sea level rise are not required because these changed conditions would occur  
17      with or without implementation of Alternative 3.

18      **Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts**  
19      **on Steelhead Rearing Habitat Following Initial Operations of CM1.**

20      Following commencement of initial operations of CM1 and continuing through the life of the  
21      permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
22      modified operations could reduce impacts to rearing habitat under Alternative 3. The analysis  
23      required under this measure may be conducted as a part of the Adaptive Management and  
24      Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25      **Mitigation Measure AQUA-95c: Consult With NMFS, USFWS and CDFW to Identify and**  
26      **Implement Potentially Feasible Means to Minimize Effects on Steelhead Rearing Habitat**  
27      **Consistent With CM1**

28      In order to determine the feasibility of reducing the effects of CM1 operations on steelhead  
29      habitat, the BDCP proponents will consult with NMFS, USFWS, and CDFW to identify and  
30      implement any feasible operational means to minimize effects on rearing habitat. Any such  
31      action will be developed in conjunction with the ongoing monitoring and evaluation of habitat  
32      conditions required by Mitigation Measure AQUA-95a Alternative 3.

33      If feasible means are identified to reduce impacts on rearing habitat consistent with the overall  
34      operational framework of Alternative 3 without causing new significant adverse impacts on  
35      other covered species, such means shall be implemented. If sufficient operational flexibility to  
36      reduce effects on steelhead habitat is not feasible under Alternative 3 operations, achieving  
37      further impact reduction pursuant to this mitigation measure would not be feasible under this  
38      Alternative, and the impact on steelhead would remain significant and unavoidable.

39      **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

40      In general, the effects of Alternative 3 on steelhead migration conditions relative to the NAA are  
41      uncertain.

1 **Upstream of the Delta**

2 ***Sacramento River***

3 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
4 Alternative 1A, which indicates that temperatures would not be different during the periods  
5 evaluated relative to NAA.

6 *Juveniles*

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through  
8 May juvenile steelhead migration period. Flows under A3\_LLT would be 10% to 37% lower than  
9 flows under NAA during November depending on water year type, they would be up to 22% higher  
10 during October, December, April, and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
11 *Analysis*). Flows under A3\_LLT in the January and February would be similar to flows under NAA  
12 with some higher and lower flows in certain water years.

13 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
14 Alternative 1A, which indicates that temperatures would not be different during the periods  
15 evaluated relative to NAA.

16 *Adults*

17 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through  
18 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
19 *the Fish Analysis*). Flows under A3\_LLT would be lower than flows under NAA during September  
20 depending on water year type, lower by 10% to 37% in November, and generally similar to flows  
21 under NAA in the remaining six months of the period.

22 *Kelts*

23 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April  
24 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
25 *Fish Analysis*). Flows during March would be similar to NAA flows but higher in below normal,  
26 critical and above normal years (up to 13% higher) and flow would be higher during April (up to  
27 13% higher) except for being similar to NAA in critical years.

28 Overall in the Sacramento River, Alternative 3 would not result in biologically meaningful effects on  
29 juvenile, adult, or kelt steelhead migration based on mean monthly flows and water temperatures.

30 ***Clear Creek***

31 Water temperature modeling was not conducted in Clear Creek.

32 *Juveniles*

33 Flows in Clear Creek during the October through May juvenile steelhead migration period under  
34 A3\_LLT would be similar to flows under NAA except in critical years during October, November and  
35 January (7%, 9% and 7% higher, respectively), in critical years in February (6% lower), and in  
36 below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
37 *Analysis*).

1 **Adults**

2 Flows in Clear Creek during the September through March adult steelhead migration period under  
3 A3\_LLT would similar to flows under NAA except in critical years during September, October,  
4 November and January (13%, 7%, 9% and 7% higher, respectively), in critical years in February  
5 (6% lower), and in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results*  
6 *utilized in the Fish Analysis*).

7 **Kelts**

8 Flows in Clear Creek during the March through April steelhead kelt downstream migration period  
9 under A3\_LLT would be similar to or greater flows under NAA except for lower flows in below  
10 normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
11 *Analysis*).

12 Overall in Clear Creek, Alternative 3 would not have biologically meaningful effects on juvenile,  
13 adult, or kelt steelhead migration.

14 **Feather River**

15 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
16 Alternative 1A, which indicates that temperatures would not be different during the periods  
17 evaluated relative to NAA.

18 **Juveniles**

19 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
20 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
21 *utilized in the Fish Analysis*). Flows under A3\_LLT would be similar to or greater than flows under  
22 NAA in all months and water years except during October in above normal years (6% lower) and  
23 January in critical years (8% lower).

24 **Adults**

25 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
26 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would be similar to or greater than  
28 flows under NAA in all months and water years except during September in below normal years  
29 (31% lower), October in above normal years (6% lower) and January in critical years (8% lower).

30 **Kelts**

31 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
32 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
33 *Results utilized in the Fish Analysis*). Flows under A3\_LLT would generally be greater than those  
34 under NAA in both months (up to 22% higher).

35 Overall in the Feather River, project-related effects of Alternative 3 consist of negligible changes in  
36 water temperature, and negligible effects (<5%) on mean monthly flow or increases in flow that  
37 would have a beneficial effect on migration conditions for juvenile, adult and kelt steelhead.

1       **American River**

2       Water temperatures in the American River under Alternative 3 would be the same as those under  
3       Alternative 1A, which indicates that temperatures would not be different during the periods  
4       evaluated relative to NAA.

5       *Juveniles*

6       Flows in the American River at the confluence with the Sacramento River were evaluated during the  
7       October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
8       *utilized in the Fish Analysis*). Flows under A3\_LLTP would be similar to or greater than flows under  
9       NAA during the entire period except for lower flows in dry and critical years in March (7% and 9%  
10      lower).

11      *Adults*

12      Flows in the American River at the confluence with the Sacramento River were evaluated during the  
13      September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
14      *Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP would be similar to or greater than  
15      flows under NAA during the entire period except for lower flows in dry and critical years in March  
16      (7% and 9% lower) and would be lower during September for all water year types except dry and  
17      critical years (16% to 50% lower).

18      *Kelts*

19      Flows in the American River at the confluence with the Sacramento River were evaluated for the  
20      March and April kelt migration period. Flows under A3\_LLTP would generally be similar to flows  
21      under NAA except in dry and critical years during March (7% and 9% lower) (Appendix 11C,  
22      *CALSIM II Model Results utilized in the Fish Analysis*).

23      Overall in the American River, results indicate that project-related effects of Alternative 3 consist of  
24      negligible effects on temperature, negligible effects (<5%) on flow or increases in flow that would  
25      have beneficial effects on migration conditions, with decreases in flow that would be infrequent, of  
26      small magnitude, or would occur in wetter water years that would not have biologically meaningful  
27      effects on juvenile, adult, or kelt steelhead migration conditions in the American River.

28      **Stanislaus River**

29      Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
30      Alternative 1A, which indicates that temperatures would not be different during the periods  
31      evaluated relative to NAA.

32      *Juveniles*

33      Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the  
34      October through May juvenile steelhead migration period. Flows under A3\_LLTP would be similar to  
35      flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
36      *Analysis*).

1 **Adults**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the  
3 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLT would be similar flows under NAA  
5 during the entire period.

6 **Kelts**

7 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
8 March and April kelt migration period. Flows under A3\_LLT would be similar to under NAA for both  
9 months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Overall in the Stanislaus River, there would be no effects of Alternative 3 on flows or water  
11 temperatures during the juvenile, adult, or kelt steelhead migration periods.

12 **San Joaquin River**

13 Water temperature modeling was not conducted in the San Joaquin River.

14 **Juveniles**

15 Flows in the San Joaquin River at Vernalis were evaluated during the October through May juvenile  
16 steelhead migration period. Flows under A3\_LLT would be similar to flows under NAA during the  
17 entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 **Adults**

19 Flows in the San Joaquin River at Vernalis were evaluated during the September through March  
20 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
21 *Fish Analysis*). Flows under A3\_LLT would be similar flows under NAA during the entire period.

22 **Kelts**

23 Flows in the San Joaquin River at Vernalis were evaluated for the March and April kelt migration  
24 period. Flows under A3\_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM*  
25 *II Model Results utilized in the Fish Analysis*).

26 **Mokelumne River**

27 Water temperature modeling was not conducted in the Mokelumne River.

28 **Juveniles**

29 Flows in the Mokelumne River were evaluated during the October through May juvenile steelhead  
30 migration period. Flows under A3\_LLT would be similar to flows under NAA during the entire period  
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 **Adults**

33 Flows in the Mokelumne River were evaluated during the September through March steelhead adult  
34 upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
35 Flows under A3\_LLT would be similar flows under NAA during the entire period.

1 *Kelts*

2 Flows in the Mokelumne River were evaluated for the March and April kelt migration period. Flows  
3 under A3\_LLTT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model*  
4 *Results utilized in the Fish Analysis*).

5 The through-Delta methodology for assessing steelhead Delta migration habitat conditions is fully  
6 described in the analysis of Alternative 1A.

7 **Sacramento River**

8 *Juveniles*

9 Based on DPM results for Chinook salmon (Impact AQUA-42 for Alternative 3), steelhead survival  
10 would not be expected to decrease more than 0.5% under Alternative 3.

11 *Adults*

12 The upstream adult steelhead migration occurs from September–March, peaking during December–  
13 February. The steelhead kelt downstream migration occurs from January–April. The proportion of  
14 Sacramento River water in the Delta under Alternative 3 would be similar (<10% difference) to  
15 NAA during the majority (October–March) of the adult steelhead upstream migration, including  
16 during the peak migration months (Table 11-3-14). The proportion of Sacramento River water  
17 decreases in September compared to NAA (13%). Based on the overall similarity in Sacramento  
18 River flow olfactory cues, especially during the adult upstream and kelt downstream migration  
19 periods, the effects would be expected to be similar. Alternative 3 would not have an adverse effect  
20 on adult and kelt steelhead migration through the Delta.

21 **San Joaquin River**

22 *Juveniles*

23 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of  
24 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.  
25 There no flow changes associated with the Alternatives. Alternative 3 would have no effect on  
26 steelhead migration success through the Delta.

27 *Adults*

28 Alternative 3 would slightly increase the proportion of San Joaquin River water in the Delta in  
29 September through December by 1.9% compared to NAA (Table 11-3-14). Therefore, Alternative 3  
30 would have no effect on the adult steelhead and kelt migration because olfactory cues and flow  
31 conditions would be relatively unchanged.

32 Based on DPM, through-Delta juvenile steelhead survival would not be expected to decrease more  
33 than 0.5% under Alternative 3. Alternative 3 would also not have an adverse effect on Sacramento  
34 River adult and kelt steelhead migration through the Delta. Alternative 3 would also have no effect  
35 on the San Joaquin River juvenile and adult steelhead and kelt through-Delta migrations because  
36 olfactory cues and flow conditions would be relatively unchanged.

37 **NEPA Effects:** Upstream of the Delta, the results indicate that the effect would not be adverse  
38 because the alternative does not have the potential to substantially reduce migration habitat or

1 substantially interfere with the movement of fish. Alternative 3 would have negligible effects on  
2 water temperatures in the Sacramento, Feather, American, and Stanislaus Rivers, and effects on flow  
3 would consist of negligible effects (<5% difference), beneficial effects (increases in flow to 84%), or  
4 reductions in flow that would not have biologically meaningful effects on migration conditions based  
5 on the infrequency of occurrence throughout a relatively long migration period (to -68%), moderate  
6 magnitude (i.e., more routine reductions in flow to -16%), and/or timing of the reduction (i.e., larger  
7 reductions in wetter water years when effects on migration would not be critical).

8 Near-field effects of Alternative 3 NDD on Sacramento River steelhead related to impingement and  
9 predation associated with three new intake structures could result in negative effects on juvenile  
10 migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected  
11 that the level of near-field impacts would be directly correlated to the number of new intake  
12 structures in the river and thus the level of impacts associated with 2 new intakes would be  
13 considerably lower than those expected from having 5 new intakes in the river. Estimates within the  
14 effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~  
15 12% mortality above current baseline levels). CM15 would be implemented with the intent of  
16 providing localized and temporary reductions in predation pressure at the NDD. Additionally,  
17 several pre-construction surveys to better understand how to minimize losses associated with the 2  
18 new intake structures will be implemented as part of the final NDD screen design effort. Alternative  
19 3 also includes an Adaptive Management Program and Real-Time Operational Decision-Making  
20 Process to evaluate and make limited adjustments intended to provide adequate migration  
21 conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere  
22 in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the  
23 NDD remains highly uncertain.

24 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
25 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
26 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 3  
27 predict improvements in smolt condition and survival associated with increased access to the Yolo  
28 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
29 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
30 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

31 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
32 all of these elements of BDCP operations and conservation measures to predict smolt migration  
33 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
34 migration survival under Alternative 3 would be similar to those estimated for NAA. Further  
35 refinement and testing of the DPM, along with several ongoing and planned studies related to  
36 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
37 future. These efforts are expected to improve our understanding of the relationships and  
38 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
39 around the potential effects of BDCP implementation on migration conditions for steelhead.  
40 However, until these efforts are completed and their results are fully analyzed, the overall  
41 cumulative effect of Alternative 3 on steelhead migration remains uncertain.

42 **CEQA Conclusion:** In general, under Alternative 3, migration conditions for steelhead would not be  
43 reduced relative to Existing Conditions.

1 **Upstream of the Delta**

2 ***Sacramento River***

3 Water temperatures in the Sacramento River under Alternative 3 would be the same as those under  
4 Alternative 1A, Impact AQUA-96, which indicates that temperatures would not be different during  
5 the periods evaluated relative to Existing Conditions.

6 *Juveniles*

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through  
8 May juvenile steelhead migration period. Flows under A3\_LLTP would be 9% to 27% lower than  
9 flows under Existing Conditions during November depending on water year type and would be up to  
10 22% higher during January and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
11 *Analysis*). Flows under A3\_LLTP in the remaining five months of the migration period would be  
12 similar to flows under Existing Conditions.

13 *Adults*

14 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through  
15 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
16 *the Fish Analysis*). Flows under A3\_LLTP would be lower than flows under Existing Conditions during  
17 September depending on water year type, lower by 7% to 27% in November, and similar to flows  
18 under Existing Conditions in the remaining six months of the period.

19 *Kelts*

20 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April  
21 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
22 *Fish Analysis*). Flows during these two months would not differ between Existing Conditions and  
23 A3\_LLTP except for being higher by 13% in critical years in March and being 18% lower in wet years  
24 in April.

25 Overall in the Sacramento River, effects of Alternative 3 on water temperatures and mean monthly  
26 flow conditions during the applicable migration periods would not have biologically meaningful  
27 effects on migration.

28 ***Clear Creek***

29 Water temperature modeling was not conducted in Clear Creek.

30 *Juveniles*

31 Flows in Clear Creek during the October through May juvenile steelhead migration period under  
32 A3\_LLTP would be similar to or greater than flows under Existing Conditions except in critical years  
33 during February (6% lower), and in below normal years in March (6% lower) (Appendix 11C,  
34 *CALSIM II Model Results utilized in the Fish Analysis*).

35 *Adults*

36 Flows in Clear Creek during the September through March adult steelhead migration period under  
37 A3\_LLTP would generally be similar to or greater than flows under Existing Conditions except in

1 critical years during September (37% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
2 *Fish Analysis*).

3 ***Kelts***

4 Flows in Clear Creek during the March through April steelhead kelt downstream migration period  
5 under A3\_LLTT would be similar to or greater flows under Existing Conditions (Appendix 11C,  
6 *CALSIM II Model Results utilized in the Fish Analysis*).

7 Overall in Clear Creek, Alternative 3 would have primarily negligible effects (<5%) on flows or  
8 would cause increases in mean monthly flow that would be beneficial for juvenile, adult, and kelt  
9 migration conditions.

10 ***Feather River***

11 Water temperatures in the Feather River under Alternative 3 would be the same as those under  
12 Alternative 1A, which indicates that temperatures would not be different during the periods  
13 evaluated relative to Existing Conditions.

14 ***Juveniles***

15 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
16 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
17 *utilized in the Fish Analysis*). Flows under A3\_LLTT would be similar to or greater than flows under  
18 Existing Conditions in all months and water years except during October, November, January and  
19 March in below normal years (6%,11%, 10%, and 12% lower, respectively), and during April and  
20 May in wet years (24% and 19% lower, respectively).

21 ***Adults***

22 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
23 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*  
24 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLTT would be up to 24% lower than  
25 flows under Existing Conditions during September, 6% lower than flows under Existing Conditions  
26 during October in below normal years, 11% lower than flows under Existing Conditions during  
27 November in below normal years, 10% lower than flows under Existing Conditions during January  
28 in below normal years and generally greater than flows under Existing Conditions in all other water  
29 years and months of the period.

30 ***Kelts***

31 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
32 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
33 *Results utilized in the Fish Analysis*). Flows under A3\_LLTT would be greater than those under Existing  
34 Conditions in both months except for being 12% lower in below normal years during March and  
35 24% lower in wet year during April.

36 Overall in the Feather River, effects of Alternative 3 on flow would not have biologically meaningful  
37 effects on juvenile, adult or kelt migration conditions above Thermalito Afterbay or at the  
38 confluence with the Sacramento River.

1 **American River**

2 Water temperatures in the American River under Alternative 3 would be the same as those under  
3 Alternative 1A, Impact AQUA-96, which indicates that temperatures would be higher during  
4 substantial portions of the juvenile and adult migration periods relative to Existing Conditions.

5 *Juveniles*

6 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
7 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*  
8 *utilized in the Fish Analysis*). Flows under A3\_LLTP would be greater than flows under Existing  
9 Conditions in and October (up to 30% higher), generally higher in January, February, March and  
10 April except for dry and critical years in January, critical years in February and March, and above  
11 normal years in April. Flows would be lower than under Existing Conditions in November during all  
12 water year types (up to 35% lower), and in December under all water year types (up to 21% lower)  
13 except for wet and below normal years. Flow in January would be greater than flows under Existing  
14 Conditions in wet, above normal, and below normal years and below Existing Conditions in dry and  
15 critical years.

16 *Adults*

17 Flows in the American River at the confluence with the Sacramento River were evaluated during the  
18 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*). Flows under A3\_LLTP would be greater than flows under  
20 Existing Conditions in and October (up to 30% higher), generally higher in January, February, March  
21 and April except for dry and critical years in January, critical years in February and March, and  
22 above normal years in April. Flows would be lower than under Existing Conditions in September and  
23 November during all water year types (up to 55% and 35% lower, respectively), and in December  
24 under all water year types (up to 21% lower) except for wet and below normal years. Flow in  
25 January would be greater than flows under Existing Conditions in wet, above normal, and below  
26 normal years and below Existing Conditions in dry and critical years.

27 *Kelts*

28 Flows in the American River at the confluence with the Sacramento River were evaluated for the  
29 March and April kelt migration period. Flows under A3\_LLTP would generally be greater than flows  
30 under Existing Conditions except in critical years during March (12% lower) and in above normal  
31 years in April (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 Overall in the American River, Alternative 3 would have significant impacts on juvenile and adult  
33 migration conditions through persistent and moderate to substantial flow reductions during drier  
34 water years. Alternative 3 would not affect kelt migration. Increases in mean monthly flow for some  
35 months and water year types would have beneficial impacts on steelhead for a portion of the  
36 migration period for juveniles and adults.

37 **Stanislaus River**

38 Flows in the Stanislaus River for Alternative 3 are substantially below those under Existing  
39 Conditions for juveniles, adults, or kelts (e.g., 36% lower in dry water years in February).

1 Water temperatures in the Stanislaus River under Alternative 3 would be the same as those under  
2 Alternative 1A, which indicates that temperatures would not be different during substantial  
3 portions of the periods evaluated relative to Existing Conditions.

#### 4 ***San Joaquin River***

5 Flows in the San Joaquin River for Alternative 3 are substantially below those under Existing  
6 Conditions for juveniles, adults or kelts (e.g., 16% lower in below normal years in March) except for  
7 similar flow conditions in November and December and somewhat higher flow conditions in some  
8 water years for January (up to 10% higher).

9 Water temperature modeling was not conducted in the San Joaquin River.

#### 10 ***Mokelumne River***

11 Flows in the Mokelumne River for Alternative 3 are substantially below those under Existing  
12 Conditions for juveniles, adults or kelts (e.g., 18% lower in dry years in May) except for somewhat  
13 higher flow conditions in some water years for January and February (up to 18% higher) and  
14 generally higher flows for all water years in December (up to 15% higher).

15 Water temperature modeling was not conducted in the Mokelumne River.

#### 16 **Through-Delta**

17 Based on DPM results for Chinook salmon (see Impact AQUA-42), steelhead survival would not be  
18 expected to decrease more than 0.5%.

19 The proportion of Sacramento River water in the Delta under Alternative 3 would to be similar to  
20 Existing Conditions (<10% difference) during the entire adult steelhead upstream and kelt  
21 downstream migrations.

#### 22 **Summary of CEQA Conclusion**

23 Collectively, the results of the Impact AQUA-96 CEQA analysis indicate that the difference between  
24 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
25 alternative could substantially reduce the availability of suitable migration habitat and interfere  
26 with the movement of fish, contrary to the NEPA conclusion set forth above. Relative to the CEQA  
27 baseline, Alternative 3 would degrade migration conditions in the American and Stanislaus rivers  
28 (based on persistent flow reductions and water temperature increases) and in the San Joaquin and  
29 Mokelumne rivers (based on persistent flow reductions). However, Alternative 3 would not have  
30 biologically meaningful impacts on juvenile, adult, or kelt migration in the Sacramento River, Clear  
31 Creek, or the Feather River. There would be no effects on through-Delta migration conditions  
32 because changes in juvenile survival and adult olfactory cues would be negligible.

33 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
34 change, future water demands, and implementation of the alternative. The analysis described above  
35 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
36 alternative from those of sea level rise, climate change and future water demands using the model  
37 simulation results presented in this chapter. However, the increment of change attributable to the  
38 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
39 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT

1 implementation period, which does include future sea level rise, climate change, and water  
2 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
3 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
4 effect of the alternative from those of sea level rise, climate change, and water demands.

5 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
6 term implementation period and Alternative 3 indicates that flows in the locations and during the  
7 months analyzed above would generally be similar between Existing Conditions during the LLT and  
8 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
9 found above would generally be due to climate change, sea level rise, and future demand, and not  
10 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
11 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
12 result in a significant impact on migration conditions for steelhead. This impact is found to be less  
13 than significant and no mitigation is required.

#### 14 **Restoration Measures (CM2, CM4–CM7, and CM10)**

15 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
16 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
17 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
18 restoration measures described for steelhead under Alternative 1A (Impact AQUA-97 through  
19 AQUA-99) also appropriately characterize effects under Alternative 3.

20 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

#### 21 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

#### 22 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

#### 23 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

24 **NEPA Effects:** All of these effects have been determined to result in no adverse effects on steelhead  
25 for NEPA purposes for the reasons identified for Alternative 1A. Specifically for AQUA-98, the effects  
26 of contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not  
27 be adverse. The effects of methylmercury on steelhead are uncertain.

28 **CEQA Conclusions:** All of these effects would be considered less than significant for CEQA purposes  
29 for the reasons identified for Alternative 1A.

#### 30 **Other Conservation Measures (CM12–CM19 and CM21)**

31 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
32 differences in other conservation-related fish effects are anticipated anywhere in the affected  
33 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
34 effects of other conservation measures described for steelhead under Alternative 1A (Impact AQUA-  
35 100 through AQUA-108) also appropriately characterize effects under Alternative 3.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

#### 37 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

1 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

2 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

3 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

4 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

5 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

6 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

7 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

8 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
9 **(CM21)**

10 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
11 adverse effect, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for  
12 Alternative 1A.

13 **CEQA Conclusions:** The nine impact mechanisms would be considered to range from no impact, to  
14 less than significant, or beneficial on steelhead, for the reasons identified for Alternative 1A, and no  
15 mitigation is required.

## 16 **Sacramento Splittail**

### 17 **Construction and Maintenance of CM1**

#### 18 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento** 19 **Splittail**

20 The potential effects of construction of water conveyance facilities on Sacramento splittail under  
21 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-109) except  
22 that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the  
23 effects would be proportionally less under this alternative. This would convert about 4,450 lineal  
24 feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of  
25 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
26 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
27 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
28 contaminated sediments would be similar to Alternative 1A and the same environmental  
29 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
30 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
31 effects.

32 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-109, environmental commitments and  
33 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
34 not be adverse for Sacramento splittail.

35 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-109 for Sacramento splittail, the  
36 impact of the construction of water conveyance facilities on Sacramento splittail would be less than

1 significant except for construction noise associated with pile driving. Potential pile driving impacts  
2 would be less than Alternative 1A because only two intakes would be constructed rather than five.  
3 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce  
4 that noise impact to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
8 Alternative 1A.

9 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
10 **and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
12 Alternative 1A.

13 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
14 **Splittail**

15 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
16 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-110) except  
17 that only two intakes would require maintenance under Alternative 3 rather than five under  
18 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse  
19 for Sacramento splittail.

20 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance  
21 of water conveyance facilities on Sacramento splittail would be less than significant. No mitigation  
22 would be required.

23 **Water Operations of CM1**

24 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

25 ***Water Exports from SWP/CVP South Delta Facilities***

26 Under Alternative 3, total entrainment of juvenile splittail at the south Delta facilities (based on Yolo  
27 Bypass inundation) would be 569% greater compared to NAA (Table 11-3-38). The greatest  
28 increase in total entrainment would be in above normal (1,906% increase) and below normal  
29 (749% increase) water year types. However, this effect is related to the expected increase in overall  
30 juvenile splittail abundance resulting from additional floodplain habitat in wetter years. The average  
31 per capita rate of splittail entrainment across all years would be reduced 29% for juveniles (Table  
32 11-3-39) and reduced 31% for adults (Table 11-3-40). This overall reduction in per capita salvage of  
33 splittail would be due to strict reductions in south Delta exports, especially during the winter and  
34 spring months. The relative impact of entrainment at the south Delta facilities on the splittail  
35 population would be reduced under Alternative 3 because the per capita entrainment risk would be  
36 lower compared to NAA.

1 **Table 11-3-38. Juvenile Sacramento Splittail Entrainment Index<sup>a</sup> (Yolo Bypass Days of Inundation**  
 2 **Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for**  
 3 **Alternative 3**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	6,489,911 (676%)	6,303,252 (550%)
Above Normal	699,812 (1,529%)	708,417 (1,906%)
Below Normal	21,912 (641%)	22,344 (749%)
Dry	1,804 (63%)	2,149 (85%)
Critical	-339 (-22%)	112 (10%)
All Years	2,164,276 (693%)	2,106,566 (569%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data, estimated from Yolo Bypass Inundation Method.

4

5 **Table 11-3-39. Juvenile Sacramento Splittail Entrainment Index<sup>a</sup> (Per Capita Method) at the SWP**  
 6 **and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 3**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-878,606 (-44%)	-554,287 (-33%)
Above Normal	7,377 (6%)	25,209 (22%)
Below Normal	4,763 (48%)	5,080 (53%)
Dry	-1,050 (-52%)	-559 (-37%)
Critical	-543 (-41%)	-285 (-27%)
All Years	-231,843 (-42%)	-130,296 (-29%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

7

8 **Table 11-3-40. Adult Sacramento Splittail Entrainment Index<sup>a</sup> (Salvage Density Method) at the**  
 9 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 3**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet	-2,050 (-52%)	-2,185 (-53%)
Above Normal	-1,278 (-27%)	-1,294 (-27%)
Below Normal	-922 (-27%)	-658 (-21%)
Dry	-278 (-11%)	-113 (-5%)
Critical	-490 (-15%)	-267 (-9%)
All Years	-1,138 (-33%)	-1,060 (-31%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data. Average (December–March).

10

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 The effect would be similar in type to Alternative 1A (with five intakes), but the degree would be  
3 less because Alternative 3 has only two intakes. Therefore, the risk of impingement and predation at  
4 the north Delta intakes under Alternative 3 would be 40% of the risk relative to Alternative 1A  
5 (Impact AQUA-111).

6 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

7 The effect of implementing dual conveyance for the NBA with an alternative Sacramento River  
8 intake would be the same as described under Alternative 1A (Impact AQUA-111). Reduced pumping  
9 from Barker Slough could reduce entrainment losses of larval splittail produced in the Yolo Bypass.  
10 There would be potential for increased predation and impingement risk associated with the  
11 alternative intake. Screens on the Barker Slough pumping plant currently exclude fish greater than  
12 25 mm, and the alternate intake on the Sacramento River would be screened to exclude splittail  
13 greater than 10 mm in length.

14 **Predation Associated with Entrainment**

15 Splittail predation loss at the south Delta facilities is assumed to be proportional to entrainment  
16 loss. Per capita splittail entrainment and associated predation at the south Delta would decrease  
17 29% under Alternative 3 compared to NAA.

18 Predation at the north Delta would increase due to the construction of the proposed water export  
19 facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111). Potential  
20 predation at the north Delta would be partially offset by reduced predation loss at the SWP/CVP  
21 south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions  
22 (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that the predation  
23 was not a factor currently limiting splittail abundance. Thus this level of predation loss would not be  
24 expected to adversely affect the splittail population.

25 **NEPA Effects:** In conclusion, the effect of Alternative 3 on entrainment and predation loss would not  
26 be adverse and may provide a benefit, because the magnitude of potential entrainment and  
27 predation losses at the north Delta intakes would likely be more than offset by the substantial  
28 reduction in per capita south Delta entrainment losses and the increased production of juvenile  
29 splittail from *CM2 Yolo Bypass Fisheries Enhancement*.

30 **CEQA Conclusion:** Under Alternative 3, total juvenile entrainment (based on Yolo Bypass  
31 inundation) averaged across water years would be 533% greater compared to Existing Conditions.  
32 However, operational activities associated with reduced south Delta water exports would result in  
33 an overall decrease in the proportion of splittail population entrained for all water year types.  
34 Average per capita entrainment under Alternative 3 would be 22% decreased for juveniles and 33%  
35 reduced for adult splittail relative to Existing Conditions. Entrainment of splittail would be reduced  
36 at the NBA. The impact and conclusion for predation associated with entrainment would be the  
37 same as described above.

38 In conclusion, the impact on Sacramento splittail from entrainment and predation loss would be less  
39 than significant and may provide a benefit because the increase in predation loss at the north Delta  
40 under Alternative 3 would likely be more than offset by the substantial reduction in south Delta  
41 facilities entrainment and predation loss and the increased production of juvenile splittail from CM2,  
42 *Yolo Bypass Fisheries Enhancement*, actions. No mitigation would be required.

1 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Sacramento Splittail**

3 In general, Alternative 3 would have beneficial effects on splittail spawning habitat relative to NAA  
4 due to substantial increases in the quantity and quality of suitable spawning habitat in the Yolo  
5 Bypass. There would also be beneficial effects on channel margin and side-channel spawning  
6 habitats due to moderate increases in mean monthly flow in the Sacramento River and the Feather  
7 River.

8 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream  
9 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning  
10 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not  
11 inundated, spawning in side channels and channel margins would be much more critical.

12 ***Floodplain Habitat***

13 Effects of Alternative 3 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased  
14 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the  
15 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects  
16 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 meter  
17 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored  
18 because flow velocity was generally very low throughout the modeled area for most conditions, with  
19 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a  
20 reasonable critical velocity for early life stages of splittail) (Young and Cech 1996).

21 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo  
22 Bypass inundation events compared to NAA; the changes are attributable to the influence of the  
23 Fremont Weir notch at lower flows. For the drier type years (below normal, dry, and critical),  
24 Alternative 3 results in an increase in frequency of inundation events greater than 30 days  
25 compared to NAA. For wet and above normal year types, Alternative 3 generally results in a reduced  
26 frequency of shorter-duration events and an increased frequency of the longest-duration events  
27 ( $\geq 70$  days) (Figure 11-3-4, Table 11-3-41). For below normal years, Alternative 3 would result in the  
28 occurrence of two inundation events  $\geq 70$  days, compared to no such events for NAA; and five more  
29 inundation events of 30-49 days and one more inundation event of 50-69 days, compared to NAA. In  
30 dry and critical years there would be one more inundation event of 30-49 days under Alternative 3,  
31 compared to NAA. For dry and critical years, project-related increases are for 30-49 day duration  
32 events only as there are no events of longer duration. These results indicate that overall project-  
33 related effects consist of an increase in occurrence of longer-duration inundation events that would  
34 be beneficial for splittail spawning by creating better spawning habitat conditions.

35 There would be increases in area of suitable splittail habitat in Yolo Bypass under A3\_LL1T ranging  
36 from 5 to 954 acres relative to NAA. Areas under A3\_LL1T would be 57%, 64%, and 285% greater  
37 than areas under NAA in wet, above normal, and below normal water years, respectively (Table 11-  
38 3-42). There would be increases in area under A3\_LL1T in dry and critical years relative to NAA, but  
39 they would be minimal (9 and 5 acres, respectively). These results indicate that there would be  
40 increases in inundated acreage in each water year type which would result in increased habitat and  
41 have a beneficial effect on splittail spawning.

42 A potential adverse effect of Alternative 3 that is not included in the modeling is reduced inundation  
43 of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. Potential effects on

1 habitat and uncertainties in predicting the magnitude of such effects would be about the same as  
2 described for Alternative 1A. Conclusions are that Alternative 3 has the potential to reduce some of  
3 the habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass  
4 inundation, but these effects have not been quantified.

5 Overall, these results that despite the potential for reductions in suitable spawning habitat in Sutter  
6 Bypass, the increased occurrence of longer-duration inundation events and increased inundation  
7 acreages in all water year types would have beneficial effects on splittail spawning habitat.

8 **Table 11-3-41. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**  
9 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**  
10 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
<b>30-49 Days</b>		
Wet	-4	-2
Above Normal	0	0
Below Normal	5	5
Dry	1	1
Critical	1	1
<b>50-69 Days</b>		
Wet	-5	-5
Above Normal	-1	-1
Below Normal	1	1
Dry	0	0
Critical	0	0
<b>≥70 Days</b>		
Wet	6	5
Above Normal	3	3
Below Normal	2	2
Dry	0	0
Critical	0	0

11  
12 **Table 11-3-42. Increase in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass from**  
13 **Existing Biological Conditions to Alternative 3 by Water Year Type from 15 2-D and Daily CALSIM II**  
14 **Modeling Runs**

Water Year Type	A3_LLT vs. EXISTING CONDITIONS	A3_LLT vs. NAA
Wet	1,093 (71%)	954 (57%)
Above Normal	746 (65%)	737 (64%)
Below Normal	357 (272%)	362 (285%)
Dry	9 (NA)	9 (NA)
Critical	5 (NA)	5 (NA)

NA = could not be calculated because the denominator was 0.

### 1 **Channel Margin and Side-Channel Habitat**

2 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel  
3 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,  
4 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are  
5 affected by changes in flow because greater flows cause more flooding, thereby increasing  
6 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially  
7 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are  
8 expected to be most important to the splittail population because in years of high-flows, when most  
9 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively  
10 little production.

11 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions  
12 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the  
13 Sacramento River for the time-frame February through June. These are the most important months  
14 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from  
15 the side-channel habitats during May and June if conditions become unfavorable.

16 Differences between model scenarios for monthly average flows during February through June by  
17 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather  
18 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 For the Sacramento River at Wilkins Slough, flows during February through March under A3\_LL  
20 T would be similar to flows under NAA. During April and June flows would be higher in most water  
21 years and in May they would be higher in all water years under NAA, resulting in a beneficial effect  
22 on rearing conditions. These results indicate that there would be some increases in flow (up to 24%)  
23 that would have beneficial effects on splittail rearing conditions in the Sacramento River.

24 Modeling indicated no differences in project-related effects on water temperature for Alternative 3  
25 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for  
26 Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be  
27 exceeded in the Sacramento River and would rarely be exceeded in the Feather River. Therefore,  
28 effects of Alternative 3 on water temperatures would not affect splittail spawning habitat conditions.

### 29 **Stranding Potential**

30 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,  
31 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and  
32 historical data to evaluate possible stranding effects, potential effects have been evaluated with a  
33 narrative summary. Effects for Alternative 3 would be as described for Alternative 1A, which  
34 concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of  
35 stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits,  
36 while keeping water away from other areas to reduce stranding in isolated ponds.

37 **NEPA Effects:** Collectively, these results indicate the effect on spawning habitat for Sacramento  
38 splittail would not be adverse because it would not substantially reduce suitable spawning habitat  
39 or substantially reduce the number of fish as a result of egg mortality. Alternative 3 would result in  
40 increased spawning habitat in Yolo Bypass, would have negligible effects (<5% difference) or  
41 beneficial effects (based on increases in mean monthly flow to 32%) on channel margin and side-  
42 channel rearing habitats, and would have negligible effects on spawning conditions based on  
43 stranding potential (flow reductions) and changes in water temperature.

1 **CEQA Conclusion:** In general, Alternative 3 would have beneficial effects on splittail spawning  
2 habitat relative to the Existing Conditions based on substantial increases in the quantity and quality  
3 of suitable spawning habitat in the Yolo Bypass. There would also be beneficial impacts on channel  
4 margin and side-channel spawning habitat due to moderate increases in mean monthly flow in the  
5 Sacramento River and the Feather River.

#### 6 **Floodplain Habitat**

7 Comparisons of Yolo Bypass inundation events with durations longer than 30 days under  
8 Alternative 3 relative to Existing Conditions (Table 11-3-41) indicate only small differences that  
9 would not likely have biologically meaningful effects on spawning conditions. In terms of acreage of  
10 suitable splittail spawning habitat in Yolo Bypass under Alternative 3 compared to Existing  
11 Conditions (Table 11-3-42), there would be substantial increases in acreages in all water year types,  
12 with increases of between 5 and 1,093 acres of suitable spawning habitat depending on water year  
13 type. Increased areas for wet, above normal, and below normal water years are predicted to be 71%,  
14 65%, and 272%, respectively, for Alternative 3. Comparisons for dry and critical water years  
15 indicate project-related increases of 9 and 5 acres of suitable spawning habitat, respectively,  
16 compared to 0 acres for Existing Conditions. These results indicate that Alternative 3 would have  
17 beneficial effects on splittail habitat through increasing spawning habitats by up to 272%.

#### 18 **Channel Margin and Side-Channel Habitat**

19 Modeled flows were in the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model*  
20 *Results utilized in the Fish Analysis*) for February to June splittail spawning and early life stage  
21 rearing period (Appendix 11C, *CALSIM II Model Results Utilized in the Fish Analysis*). Results indicate  
22 that Alternative 3 would have negligible effects (<5%) during February and March, small to  
23 moderate increases in flow (to 16%) during April, larger increases during May and June (to 39%)  
24 and only one small reduction in flow (-13%) during May in wet years. These results indicate that  
25 effects of Alternative 3 on flows would generally have beneficial effects on splittail spawning and  
26 rearing conditions in the upper Sacramento River.

27 Flows in the Feather River at the confluence with the Sacramento River were evaluated during  
28 February through June. Flows during this period would show variable effects of A3\_LL1 compared to  
29 Existing Conditions depending on month and water year type, with primarily negligible effects  
30 (<5%) or increases in flow (to 27%) that would have beneficial effects on rearing conditions. There  
31 would be occurrences of small (-11%) to moderate (-24%) decreases in mean monthly flow under  
32 Alternative 3, including in drier water year types during March (-12% in below normal years) and  
33 most of June (-11% and -17% in dry and critical years) when effects of flow reductions would be  
34 more critical for rearing conditions. These results indicate that for the majority of the rearing  
35 period, Alternative 3 would result in increased flow in the Feather River that would have a positive  
36 effect on splittail rearing in channel margin and side-channel habitats. Flow reductions in drier  
37 water years would be infrequent and of relatively small magnitude and would not have biologically  
38 meaningful effects on splittail spawning success.

39 Modeling results indicate no differences in project-related effects on water temperature for  
40 Alternative 3 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling  
41 results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would  
42 not be exceeded in the Sacramento River and rarely exceeded in the Feather River. Therefore,  
43 impacts on spawning habitat for Sacramento splittail would not be biologically meaningful.

1       **Stranding Potential**

2       As described in the NEPA effects section above, rapid reductions in flow can dewater channel  
3       margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a  
4       lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects  
5       have been evaluated with a narrative summary. Effects for Alternative 3 would be as described for  
6       Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to  
7       further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to  
8       maximize biological benefits, while keeping water away from other areas to reduce stranding in  
9       isolated ponds.

10       **Summary of CEQA Conclusion**

11       Collectively, these results indicate the impact on spawning habitat for Sacramento splittail would be  
12       less than significant because it would not substantially reduce suitable spawning habitat or  
13       substantially reduce the number of fish as a result of egg mortality. No mitigation would be  
14       necessary. Alternative 3 would result in increased spawning habitat in Yolo Bypass, and would have  
15       negligible effects on spawning conditions based on stranding potential (flow reductions) and  
16       changes in water temperature. Effects of Alternative 3 on mean monthly flows would consist of less-  
17       than-significant impacts (<5% difference), beneficial impacts based on increases in mean monthly  
18       flow to 27%, and infrequent small (-11%) to moderate (-24%) decreases in flow that would not  
19       have biologically meaningful impacts on channel margin and side-channel rearing habitats.

20       **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

21       In general, Alternative 3 would have beneficial effects on splittail rearing habitat relative to NAA  
22       based on the beneficial effects on floodplain habitat in the Yolo Bypass and channel margin and side-  
23       channel habitats in the Sacramento River and the Feather River described in the previous impact  
24       discussion, Impact AQUA-112. Sacramento splittail rear in floodplain and main-channel  
25       environments; the analyses of splittail weighted habitat area in Yolo Bypass and effects of flow  
26       conditions on channel margin and side-channel habitats provided in the previous impact apply to  
27       rearing as well as spawning habitat for splittail.

28       **NEPA Effects:** Effects of Alternative 3 on flow would not have meaningful negative effects on the  
29       availability of channel margin and main-channel habitat, and would have beneficial effects from  
30       increases in mean monthly flow. Increased flows into Yolo Bypass may reduce flooding and flooded  
31       rearing habitat to some extent in the Sutter Bypass but would create habitat in the Yolo Bypass that  
32       would have a beneficial effect on rearing conditions.

33       **CEQA Conclusion:** In general, operations under Alternative 3 would have beneficial impacts on  
34       splittail rearing habitat relative to the Existing Conditions based on the beneficial impacts on  
35       floodplain habitat in the Yolo Bypass and channel margin and side-channel habitats in the  
36       Sacramento River and the Feather River described in Impact AQUA-112. Impacts on splittail rearing  
37       habitat are about the same as described for spawning habitat in Impact AQUA-112. As concluded  
38       above, the impact would be less than significant and no mitigation would be required. Effects of  
39       Alternative 3 on flow would not have meaningful negative impacts on the availability of channel  
40       margin and main-channel habitat, and would have beneficial impacts from increases in mean  
41       monthly flow. Increased flows into Yolo Bypass may reduce flooding and flooded rearing habitat to  
42       some extent in the Sutter Bypass but would create habitat in the Yolo Bypass that would have a  
43       beneficial impact on rearing conditions.

1 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
2 **Splittail**

3 In general, effects of Alternative 3 on splittail migration conditions would be beneficial relative to  
4 NAA based on increases in mean monthly flow in the Sacramento River and the Feather River.

5 Effects of Alternative 3 on migration conditions for Sacramento splittail would be about the same as  
6 described above for channel margin and side-channel environments (Impact AQUA-112).

7 **NEPA Effects:** As concluded above, the effect is not adverse. Effects of Alternative 3 on flow would  
8 not have meaningful negative effects on the availability of channel margin and main-channel habitat,  
9 and would have beneficial effects on migration conditions from increases in mean monthly flow.

10 **CEQA Conclusion:** In general, the impact of Alternative 3 on splittail migration conditions would be  
11 beneficial relative to the Existing Conditions based on increases in mean monthly flow in the  
12 Sacramento River and the Feather River.

13 Effects of Alternative 3 on migration conditions for Sacramento splittail would be about the same as  
14 described above for channel margin and side-channel environments (Impact AQUA-112). As  
15 concluded above, the impact would be less than significant and no mitigation would be necessary.  
16 Effects of Alternative 3 on flow would not have meaningful negative impacts on the availability of  
17 channel margin and main-channel habitat, and would have beneficial impacts on migration  
18 conditions from increases in mean monthly flow.

19 **Restoration Measures (CM2, CM4–CM7, and CM10)**

20 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
21 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
22 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
23 restoration measures described for Sacramento splittail under Alternative 1A (Impact AQUA-115  
24 through AQUA-117) also appropriately characterize effects under Alternative 3.

25 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

26 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

27 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**  
28 **Sacramento Splittail**

29 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

30 **NEPA Effects:** All three of these effects have been determined to result in no adverse effects on  
31 Sacramento splittail. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail  
32 with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of  
33 methylmercury on Sacramento splittail are uncertain.

34 **CEQA Conclusion:** These three impacts would be considered less than significant for the reasons  
35 identified for Alternative 1A.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
3 differences in other conservation-related fish effects are anticipated anywhere in the affected  
4 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
5 effects of other conservation measures described for Sacramento splittail under Alternative 1A  
6 (Impact AQUA-118 through AQUA-126) also appropriately characterize effects under Alternative 3.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

8 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

9 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**  
10 **Splittail (CM13)**

11 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
12 **(CM14)**

13 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
14 **(CM15)**

15 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

16 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

17 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

18 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

19 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**  
20 **Splittail (CM21)**

21 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no  
22 adverse effect, or beneficial effects on Sacramento splittail for NEPA purposes, for the reasons  
23 identified for Alternative 1A.

24 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to  
25 less than significant, or beneficial on Sacramento splittail, for the reasons identified for Alternative  
26 1A, and no mitigation is required.

27 **Green Sturgeon**

28 **Construction and Maintenance of CM1**

29 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

30 The potential effects of construction of water conveyance facilities on green sturgeon under  
31 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-127) except  
32 that Alternative 3 includes two intakes compared to five intakes under Alternative 1A, so the effects  
33 would be proportionally less under this alternative. This would convert about 4,450 lineal feet of  
34 existing shoreline habitat into intake facility structures and would require about 10.2 acres of

1 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
2 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
3 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
4 contaminated sediments would be similar to Alternative 1A and the same environmental  
5 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
6 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
7 effects.

8 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and  
9 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
10 not be adverse for green sturgeon

11 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-127, the impact of the construction  
12 of water conveyance facilities on green sturgeon would be less than significant except for  
13 construction noise associated with pile driving which would only occur for two intakes rather than  
14 five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would  
15 reduce the noise impact to less than significant.

16 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
17 **of Pile Driving and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
19 Alternative 1A.

20 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
21 **and Other Construction-Related Underwater Noise**

22 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
23 Alternative 1A.

24 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

25 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
26 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-128) expect  
27 that only two intakes would need to be maintained under Alternative 3 rather than five as under  
28 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-128, the effect would not be adverse  
29 for green sturgeon.

30 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-128, the impact of the maintenance  
31 of water conveyance facilities on green sturgeon would be less than significant and no mitigation  
32 would be required.

33 **Water Operations of CM1**

34 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

35 **NEPA Effects:** Alternative 3 would result in an overall reduction in entrainment of green sturgeon  
36 across all water years compared to NAA (Table 11-3-43). Similar to Alternative 1A, entrainment  
37 reductions would be greater in wet and above normal water year types (40% decrease, 47 fish) than  
38 in below normal, dry, and critical years (19% decrease, 2–10 fish) compared to NAA. Alternative 3  
39 would not have adverse effects on juvenile green sturgeon and may be beneficial due to the

1 reduction in entrainment at the south Delta export facilities for all water year types compared to  
2 NAA (Table 11-3-43).

3 **Table 11-3-43. Juvenile Green Sturgeon Entrainment Index<sup>a</sup> at the SWP and CVP Salvage**  
4 **Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 3**

Water Year Type <sup>b</sup>	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
Wet and Above Normal	-44 (-39%)	-47 (-40%)
Below Normal, Dry, and Critical	-2 (-15%)	-10 (-19%)
All Years	-51 (-32%)	-56 (-34%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.

<sup>b</sup> Sacramento Valley water year-types.

5

6 ***Predation Associated with Entrainment***

7 Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to  
8 entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation  
9 loss, would change minimally between Alternative 3 and NAA (56 fish). The number of juvenile  
10 green sturgeon lost to predation at the south Delta facilities would change negligibly between  
11 Alternative 3 and NAA. The impact and conclusion for predation risk associated with NPB structures  
12 and the north Delta intakes would be the same as described for Alternative 1A (Impact AQUA-129).  
13 The effect on predation loss under Alternative 3 would not be adverse.

14 ***CEQA Conclusion:*** As described above, annual entrainment losses of juvenile green sturgeon across  
15 all years would decrease by about 51 fish, or 32% under Alternative 3 (A3\_LLT) relative to Existing  
16 Conditions (Table 11-3-43). Impacts of water operations on entrainment of green sturgeon would be  
17 beneficial and no mitigation would be required.

18 The impact and conclusion for predation associated with entrainment would be the same as  
19 described immediately above. Since few juvenile green sturgeon are entrained at the south Delta,  
20 reductions in entrainment (32% reduction compared to Existing Conditions, representing 51 fish)  
21 under Alternative 3, would have little effect on entrainment-related predation loss. Overall, the  
22 impact would be less than significant, because there would be little change in predation loss under  
23 Alternative 3.

24 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
25 **Green Sturgeon**

26 In general, Alternative 3 would reduce spawning and egg incubation habitat for green sturgeon  
27 relative to the NAA.

28 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
29 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows  
30 can reduce the instream area available for spawning and egg incubation. Flows under A3\_LLT would  
31 always be similar to or greater than flows under NAA, indicating there would be very few reductions  
32 in flows in the Sacramento River under Alternative 3 although flows can be lower or higher in

1 individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
2 *Analysis*).

3 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with  
4 the Sacramento River during the February through June green sturgeon spawning and egg  
5 incubation period. Flows under A3\_LLT would be similar to or greater than flows under NAA in both  
6 locations, except in critical years during June at the confluence. These results indicate that there  
7 would be very few reductions in flows in the Feather River under Alternative 3 independent of  
8 climate change (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 Water temperatures in the Sacramento and Feather rivers under Alternative 3 would be the same as  
10 those under Alternative 1A, Impact AQUA-130, which indicates that there would be no effect on  
11 temperatures during the period evaluated relative to NAA.

12 Flows in the San Joaquin River at Vernalis under Alternative 3 during March through June would not  
13 be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
14 *Analysis*).

15 No water temperatures modeling was conducted in the San Joaquin River.

16 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not  
17 have the potential to substantially reduce the amount of suitable habitat. Flows in the Sacramento,  
18 Feather, and San Joaquin Rivers and water temperatures in the Sacramento and Feather Rivers  
19 would be similar between Alternative 3 and NAA during the green sturgeon spawning and egg  
20 incubation period.

21 **CEQA Conclusion:** In general, Alternative 3 would reduce spawning and egg incubation habitat for  
22 green sturgeon relative to the Existing Conditions.

23 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
24 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under  
25 A3\_LLT would generally be similar to or greater than those under Existing Conditions, except in wet  
26 years during May at Keswick and Red Bluff (18% and 14% lower, respectively), and in below normal  
27 years during March at Keswick (6% lower) and in dry and critical years during July at Keswick (6%  
28 and 11% lower, respectively) and Red Bluff (6% and 10% lower, respectively) (Appendix 11C,  
29 *CALSIM II Model Results utilized in the Fish Analysis*). Also, flows can be lower or higher in  
30 individual months of individual years. These results indicate that there would be few reductions in  
31 flows in the Sacramento River under Alternative 3 relative to the Existing Conditions.

32 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with  
33 the Sacramento River during the March through July green sturgeon spawning and egg incubation  
34 period. At Thermalito Afterbay, flows under A3\_LLT would generally be similar to or greater than  
35 those under Existing Conditions, except in below normal years during February and March and in  
36 wet years during May, in which flows under A3\_LLT would be up to 33% lower than under Existing  
37 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence  
38 with the Sacramento River, flows under A3\_LLT would generally be similar to or greater than flows  
39 under Existing Conditions, except in below normal years during March, in wet years during May, and  
40 in most water years during June, in which flows under A3\_LLT would be up to 24% lower than  
41 under Existing Conditions. These results indicate that there would be few reductions in flows in the  
42 Feather River under Alternative 3 relative to the Existing Conditions.

1 Water temperatures in the Sacramento and Feather Rivers under Alternative 3 would be the same  
2 as those under Alternative 1A, Impact AQUA-130, which indicates that temperatures would be  
3 higher in both rivers during the periods evaluated relative to Existing Conditions.

4 Flows in the San Joaquin River at Vernalis under Alternative 3 would be up to 43% lower than flows  
5 under Existing Conditions during the March through June spawning and egg incubation period  
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 No water temperature modeling was conducted for the San Joaquin River.

#### 8 **Summary of CEQA Conclusion**

9 Collectively, the results of the Impact AQUA-96 CEQA analysis indicate that the difference between  
10 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
11 alternative could substantially reduce the availability of suitable migration habitat and interfere  
12 with the movement of fish, contrary to the NEPA conclusion set forth above. Flows in the  
13 Sacramento and Feather Rivers during the green sturgeon spawning and egg incubation period  
14 would be similar between Existing Conditions and Alternative 3. However, water temperatures in  
15 both rivers would be greater under Alternative 3 relative to Existing Conditions. Temperature  
16 increases in these rivers could lead to reduced hatching success and egg mortality under Alternative  
17 3. Further, Flows in the San Joaquin River would be substantially lower throughout the spawning  
18 and egg incubation period under Alternative 3, which could reduce habitat conditions and lead to  
19 dewatering of eggs.

20 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
21 change, future water demands, and implementation of the alternative. The analysis described above  
22 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
23 alternative from those of sea level rise, climate change and future water demands using the model  
24 simulation results presented in this chapter. However, the increment of change attributable to the  
25 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
26 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
27 implementation period, which does include future sea level rise, climate change, and water  
28 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
29 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
30 effect of the alternative from those of sea level rise, climate change, and water demands.

31 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
32 term implementation period and Alternative 3 indicates that flows in the locations and during the  
33 months analyzed above would generally be similar between Existing Conditions during the LLT and  
34 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
35 found above would generally be due to climate change, sea level rise, and future demand, and not  
36 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
37 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
38 result in a significant impact on spawning and egg incubation habitat for green sturgeon. This  
39 impact is found to be less than significant and no mitigation is required.

#### 40 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

41 In general, Alternative 3 would not affect the quantity and quality of green sturgeon larval and  
42 juvenile rearing habitat relative to NAA.

1 Water temperature was used to determine the potential effects of Alternative 3 on green sturgeon  
2 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
3 their habitat is more likely to be limited by changes in water temperature than flow rates. Water  
4 temperatures in the Sacramento River and Feather River for Alternative 3 are not different from  
5 those for Alternative 1A, which indicates that Alternative 3 would not affect temperatures relative to  
6 NAA in either river relative to NAA.

7 Water temperature modeling was not conducted in the San Joaquin River.

8 **NEPA Effects:** Collectively, these results indicate that this effect would not be adverse because it  
9 does not have the potential to substantially reduce the amount of suitable rearing habitat. Water  
10 temperature conditions in the Sacramento and Feather Rivers under Alternative 3 would not differ  
11 from those under the NEPA baseline during the green sturgeon juvenile rearing period.

12 **CEQA Conclusion:** In general, Alternative 3 would not affect the quantity and quality of green  
13 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

14 Water temperature was used to determine the potential effects of Alternative 3 on green sturgeon  
15 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
16 their habitat is more likely to be limited by changes in water temperature than flow rates. Water  
17 temperatures in the Sacramento River and Feather River for Alternative 3 are not different from  
18 those for Alternative 1A discussed in Impact AQUA-131, which indicates that there would be  
19 increase in temperatures in both rivers relative to Existing Conditions.

20 Water temperature modeling was not conducted in the San Joaquin River.

#### 21 **Summary of CEQA Conclusion**

22 Collectively, the results of the Impact AQUA-96 CEQA analysis indicate that the difference between  
23 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
24 alternative could substantially reduce the availability of suitable migration habitat and interfere  
25 with the movement of fish, contrary to the NEPA conclusion set forth above. Water temperatures  
26 would be higher under Alternative 3 relative to Existing Conditions in the Sacramento and Feather  
27 Rivers during the green sturgeon juvenile rearing period.

28 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
29 change, future water demands, and implementation of the alternative. The analysis described above  
30 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
31 alternative from those of sea level rise, climate change and future water demands using the model  
32 simulation results presented in this chapter. However, the increment of change attributable to the  
33 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
34 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
35 implementation period, which does include future sea level rise, climate change, and water  
36 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
37 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
38 effect of the alternative from those of sea level rise, climate change, and water demands.

39 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
40 term implementation period and Alternative 3 indicates that flows in the locations and during the  
41 months analyzed above would generally be similar between Existing Conditions during the LLT and  
42 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3

1 found above would generally be due to climate change, sea level rise, and future demand, and not  
2 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
3 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
4 result in a significant impact on rearing habitat for green sturgeon. This impact is found to be less  
5 than significant and no mitigation is required.

### 6 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

7 In general, Alternative 3 would reduce green sturgeon migration conditions relative to NAA.

8 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
9 Keswick Dam and Wilkins Slough and in the Feather River between Thermalito Afterbay and the  
10 confluence with the Sacramento River during the April through October larval migration period, the  
11 August through March juvenile migration period, and the November through June adult migration  
12 period (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). Because these periods  
13 encompass the entire year, flows during all months were compared. Reduced flows could slow or  
14 inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream  
15 migration cues and pass impediments by adults.

16 Sacramento River flows under A3\_LLT would generally be similar to or greater than flows under  
17 NAA in all months except August, September, and November, during which flows would be up to  
18 45% lower depending on location, month, and water year type.

19 Feather River flows under A3\_LLT would generally be lower by up to 84% than those under NAA  
20 during July through September. Flows during other months under A3\_LLT would generally be  
21 similar to or greater than flows under NAA with some exceptions.

22 Larval transport flows were also examined by utilizing the positive correlation between white  
23 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the  
24 assumption that the mechanism responsible for the relationship is that Delta outflow provides  
25 improved green sturgeon larval transport that results in improved year class strength. Results for  
26 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation  
27 between Delta outflow and year class strength, green sturgeon year class strength would be lower  
28 under Alternative 3.

29 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the  
30 potential to substantially interfere with the movement of green sturgeon. Reductions in flows in the  
31 Sacramento and Feather rivers during summer and fall months would affect the migratory abilities  
32 of larvae and juveniles by slowing or inhibiting downstream migration of larvae and juveniles.

33 This effect is a result of the specific reservoir operations and resulting flows associated with this  
34 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
35 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change  
36 the alternative, thereby making it a different alternative than that which has been modeled and  
37 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible  
38 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-132a through AQUA-  
39 132c) has the potential to reduce the severity of impact, although not necessarily to a not adverse  
40 level.

41 **CEQA Conclusion:** In general, Alternative 3 would reduce green sturgeon migration conditions  
42 relative to the Existing Conditions.

1 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
2 Keswick Dam and Wilkins Slough and in the Feather River between Thermalito Afterbay and the  
3 confluence with the Sacramento River during the April through October larval migration period, the  
4 August through March juvenile migration period, and the November through July adult migration  
5 period (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). Because these periods  
6 encompass the entire year, flows during all months were compared. Reduced flows could slow or  
7 inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream  
8 migration cues and pass impediments by adults.

9 Sacramento River flows under A3\_LLTT would generally be similar to or greater than flows under  
10 Existing Conditions in all months except August, September, and November, during which flows  
11 would be up to 27% lower than under Existing Conditions (*Appendix 11C, CALSIM II Model Results  
12 utilized in the Fish Analysis*). Flows under A3\_LLTT during other months would generally be similar to  
13 or greater than flows under Existing Conditions.

14 Flows in the Feather River under A3\_LLTT would generally be up to 54% lower than flows under  
15 Existing Conditions in June, July, August, and November (*Appendix 11C, CALSIM II Model Results  
16 utilized in the Fish Analysis*). Flows during other months under A3\_LLTT would generally be similar to  
17 or greater than flows under Existing Conditions.

18 For Delta outflow, the percent of months exceeding flow thresholds under A3\_LLTT would  
19 consistently be lower than those under Existing Conditions for each flow threshold, water year type,  
20 and month (14% to 60% lower on a relative scale) (see Table 11-1A-70 below).

## 21 **Summary of CEQA Conclusion**

22 Collectively, these results indicate that the impact would be significant because it has the potential  
23 to substantially interfere with the movement of fish. The reduction in flows in the Sacramento and  
24 Feather Rivers would reduce the migration periods of larval, juvenile, and adult migration, which  
25 would substantially slow or inhibit their downstream migration. This impact is a result of the  
26 specific reservoir operations and resulting flows associated with this alternative. Applying  
27 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
28 reduce this impact to a less-than-significant level would fundamentally change the alternative,  
29 thereby making it a different alternative than that which has been modeled and analyzed. As a  
30 result, this impact is significant and unavoidable because there is no feasible mitigation available.  
31 Even so, proposed below is mitigation that has the potential to reduce the severity of impact though  
32 not necessarily to a less-than-significant level.

### 33 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional 34 Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of 35 Mitigation to Reduce Impacts to Migration Conditions**

36 Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
37 significant and unavoidable adverse effects on migration, this conclusion was based on the best  
38 available scientific information at the time and may prove to have been overstated. Upon the  
39 commencement of operations of CM1 and continuing through the life of the permit, the BDCP  
40 proponents will monitor effects on migration in order to determine whether such effects would  
41 be as extensive as concluded at the time of preparation of this document and to determine any  
42 potentially feasible means of reducing the severity of such effects. This mitigation measure

1 requires a series of actions to accomplish these purposes, consistent with the operational  
2 framework for Alternative 3.

3 The development and implementation of any mitigation actions shall be focused on those  
4 incremental effects attributable to implementation of Alternative 3 operations only.  
5 Development of mitigation actions for the incremental impact on migration attributable to  
6 climate change/sea level rise are not required because these changed conditions would occur  
7 with or without implementation of Alternative 3.

8 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**  
9 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

10 Following commencement of initial operations of CM1 and continuing through the life of the  
11 permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
12 modified operations could reduce impacts to migration under Alternative 3. The analysis  
13 required under this measure may be conducted as a part of the Adaptive Management and  
14 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

15 **Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and**  
16 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**  
17 **Conditions Consistent with CM1**

18 In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon  
19 habitat, the BDCP proponents will consult with NMFS, USFWS, and CDFW to identify and  
20 implement any feasible operational means to minimize effects on migration. Any such action will  
21 be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions  
22 required by Mitigation Measure AQUA-132a.

23 If feasible means are identified to reduce impacts on migration consistent with the overall  
24 operational framework of Alternative 3 without causing new significant adverse impacts on  
25 other covered species, such means shall be implemented. If sufficient operational flexibility to  
26 reduce effects on green sturgeon habitat is not feasible under Alternative 3 operations,  
27 achieving further impact reduction pursuant to this mitigation measure would not be feasible  
28 under this Alternative, and the impact on green sturgeon would remain significant and  
29 unavoidable.

30 **Restoration Measures (CM2, CM4–CM7, and CM10)**

31 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
32 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
33 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
34 restoration measures described for green sturgeon under Alternative 1A (Impact AQUA-133  
35 through AQUA-135) also appropriately characterize effects under Alternative 3.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

1 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

2 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**  
3 **Sturgeon**

4 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

5 *NEPA Effects:* All three of these effects have been determined to result in no adverse effects on green  
6 sturgeon for the reasons identified for Alternative 1A. Specifically for AQUA-134, the effects of  
7 contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be  
8 adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

9 *CEQA Conclusion:* All three of these impacts would be considered less than significant for the  
10 reasons identified for Alternative 1A.

11 **Other Conservation Measures (CM12–CM19 and CM21)**

12 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
13 differences in other conservation-related fish effects are anticipated anywhere in the affected  
14 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
15 effects of other conservation measures described for green sturgeon under Alternative 1A (Impact  
16 AQUA-136 through AQUA-144) also appropriately characterize effects under Alternative 3.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

18 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

19 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
20 **(CM13)**

21 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

22 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
23 **(CM15)**

24 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

25 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

26 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

27 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

28 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
29 **Sturgeon (CM21)**

30 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no  
31 adverse effect, or beneficial effects on green sturgeon for the reasons identified for Alternative 1A.

1 **CEQA Conclusions:** The nine impact mechanisms would be considered to range from no impact, to  
2 less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A,  
3 and no mitigation is required.

## 4 **White Sturgeon**

### 5 **Construction and Maintenance of CM1**

#### 6 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

7 The potential effects of construction of water conveyance facilities on white sturgeon under  
8 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-145) except  
9 that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the  
10 effects would be proportionally less under this alternative. This would convert about 4,450 lineal  
11 feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of  
12 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
13 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
14 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
15 contaminated sediments would be similar to Alternative 1A and the same environmental  
16 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in  
17 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
18 effects.

19 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and  
20 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
21 not be adverse for white sturgeon

22 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-145, the impact of the construction  
23 of water conveyance facilities on white sturgeon would be less than significant except for  
24 construction noise associated with pile driving. Potential pile driving impacts would be less than  
25 Alternative 1A because only two intakes would be constructed rather than five. Implementation of  
26 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
27 less than significant.

#### 28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
31 Alternative 1A.

#### 32 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 33 **and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
35 Alternative 1A.

#### 36 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

37 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
38 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-146) except  
39 that only two intakes would require maintenance under Alternative 3 rather than five as under

1 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse  
2 for white sturgeon.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance  
4 of water conveyance facilities on white sturgeon would be less than significant and no mitigation  
5 would be required.

6 **Water Operations of CM1**

7 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

8 Alternative 3 is expected to reduce overall entrainment of juvenile white sturgeon at the south Delta  
9 export facilities, estimated as salvage density, by about 32% (105 fish) across all water year types as  
10 compared to NAA (Table 11-3-44). Similar to Alternative 1A, entrainment would be highest in wet  
11 and above normal water years. Under Alternative 3, entrainment in wet and above normal water  
12 years would be reduced 33% (96 fish), compared to NAA. Therefore, Alternative 3 would not have  
13 adverse effects on juvenile white sturgeon and may be beneficial.

14 Overall, the potential entrainment impacts of Alternative 3 on juvenile white sturgeon would be  
15 similar to those described for Alternative 1A for operating new SWP/CVP north Delta intakes, NPBs  
16 at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs. These  
17 actions have the potential to minimize or reduce entrainment, and may be beneficial to white  
18 sturgeon.

19 **Table 11-3-44. Juvenile White Sturgeon Entrainment Index<sup>a</sup> at the SWP and CVP Salvage Facilities**  
20 **for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between**  
21 **Model Scenarios for Alternative 3**

Water Year Types <sup>b</sup>	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LL1	NAA vs. A3_LL1
Wet and Above Normal	-74 (-28%)	-96 (-33%)
Below Normal, Dry, and Critical	-6 (-16%)	-9 (-22%)
All Years	-80 (-26%)	-105 (-32%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.

<sup>b</sup> Sacramento Valley water year-types.

22

23 **Predation Associated with Entrainment**

24 Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to  
25 entrainment loss. The number of juvenile white sturgeon lost to predation at the south Delta  
26 facilities would change negligibly between Alternative 3 and NAA. The impact and conclusion for  
27 predation risk associated with NPB structures and the north Delta intakes would be the same as  
28 described for Alternative 1A (Impact AQUA-147).

29 **NEPA Effects:** Overall, the potential entrainment and predation impacts of Alternative 3 on juvenile  
30 white sturgeon would not be adverse, for the reasons described for Alternative 1A.

1 **CEQA Conclusion:** As described above, annual entrainment losses of juvenile white sturgeon  
2 associated with water exports from SWP/CVP south Delta facilities would result in an overall  
3 decrease in entrainment of 26% (80 fish) under Alternative 3 relative to Existing Conditions (Table  
4 11-3-44). Impacts of water operations on entrainment of white sturgeon would be less than  
5 significant and may be beneficial. No mitigation would be required.

6 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
7 **White Sturgeon**

8 In general, Alternative 3 would not affect spawning and egg incubation habitat for white sturgeon  
9 relative to NAA.

10 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
11 May spawning and egg incubation period for white sturgeon. Flows at both locations under A3\_LLT  
12 from February to May would be mostly similar to or greater than those under NAA, except in wet  
13 years during April (7% lower) at Verona (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
14 *Analysis*). These results indicate that there would be mostly small reductions in flows in the  
15 Sacramento River under Alternative 3.

16 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento  
17 River were examined during the February to May spawning and egg incubation period for white  
18 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A3\_LLT  
19 would be similar to or greater than flows under NAA during February to May. Flows under A3\_LLT  
20 at the confluence would always be similar to or greater than flows under NAA. These results indicate  
21 that there would be very few reductions in flows in the Feather River during the white sturgeon  
22 spawning and egg incubation period under Alternative 3.

23 Flows in the San Joaquin River under Alternative 3 would not be different from those under NAA  
24 throughout the February through May period (Appendix 11C, *CALSIM II Model Results utilized in the*  
25 *Fish Analysis*). Water temperatures in the Sacramento and Feather Rivers under Alternative 3 would  
26 not be different from those under Alternative 1A, Impact AQUA-148, which indicates that  
27 temperatures would not differ from those under NAA throughout the February through May period.

28 Water temperatures were not modeled in the San Joaquin River.

29 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not  
30 have the potential to substantially reduce the amount of suitable habitat. Reductions in flows and  
31 increases in water temperatures under Alternative 3 are small and infrequent relative to NAA and,  
32 therefore, would not have a substantial effect on the species.

33 **CEQA Conclusion:** In general, Alternative 3 would not affect spawning and egg incubation habitat for  
34 white sturgeon relative to the Existing Conditions.

35 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
36 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model*  
37 *Results utilized in the Fish Analysis*). At Wilkins Slough, flows under A3\_LLT would be similar to or  
38 greater than those under Existing Conditions, except in wet years during May (13% lower). At  
39 Verona, flows under A3\_LLT from February to May would be generally similar to or greater than  
40 Existing Conditions, except for below normal and critical years during February (6% and 7% lower,  
41 respectively), below normal years during March (13% lower), wet and above normal years during  
42 April (8% and 7% lower, respectively), and wet years during May (19% lower). These results

1 indicate that there would be mostly small reductions in flows in the Sacramento River under  
2 Alternative 3 relative to Existing Conditions.

3 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento  
4 River were examined during the February to May spawning and egg incubation period for white  
5 sturgeon (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows at Thermalito  
6 Afterbay from February to May under A3\_LL1T would generally be similar to or greater than those  
7 under Existing Conditions, except in below normal years during February and March (22% and 33%  
8 lower, respectively) and in wet years during May (30% lower). Flows at the confluence with the  
9 Sacramento River under A3\_LL1T would generally be similar to or greater than flows under Existing  
10 Conditions, except in below normal years during March (12% lower) and wet years during May  
11 (24% lower). These results indicate that there would be few reductions in flows in the Feather River  
12 under Alternative 3 relative to Existing Conditions.

13 Flows in the San Joaquin River under Alternative 3 would be similar to flows under Existing  
14 Conditions during February and up to 43% lower during March through July.

15 Water temperatures in the Sacramento and Feather Rivers under Alternative 3 would be generally  
16 the same as those under Alternative 1A, Impact AQUA-148, which indicates that there would no  
17 effect on temperatures relative to Existing Conditions.

18 Temperatures were not modeled for the San Joaquin River.

19 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between  
20 the Existing Conditions and Alternative 3 could be significant because, under the Existing  
21 Conditions, the alternative could substantially reduce the availability of suitable spawning and egg  
22 incubation habitat, contrary to the NEPA conclusion set forth above. There would be substantial  
23 reductions in the majority of the white sturgeon spawning and egg incubation period in the San  
24 Joaquin River under Alternative 3 relative to Existing Conditions, which would reduce the quality  
25 and quantity of habitat available for spawning and egg incubation in the river. There would be no  
26 other flow- or temperature-related effects of Alternative 3 on white sturgeon spawning and egg  
27 incubation.

28 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
29 change, future water demands, and implementation of the alternative. The analysis described above  
30 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
31 alternative from those of sea level rise, climate change and future water demands using the model  
32 simulation results presented in this chapter. However, the increment of change attributable to the  
33 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
34 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
35 implementation period, which does include future sea level rise, climate change, and water  
36 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
37 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
38 effect of the alternative from those of sea level rise, climate change, and water demands.

39 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
40 term implementation period and Alternative 3 indicates that flows in the locations and during the  
41 months analyzed above would generally be similar between Existing Conditions during the LLT and  
42 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
43 found above would generally be due to climate change, sea level rise, and future demand, and not

1 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
2 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
3 result in a significant impact on spawning and egg incubation habitat for white sturgeon. This  
4 impact is found to be less than significant and no mitigation is required.

#### 5 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

6 In general, Alternative 3 would not affect the quantity and quality of white sturgeon larval and  
7 juvenile rearing habitat relative to NAA.

8 Water temperature was used to determine the potential effects of Alternative 3 on white sturgeon  
9 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
10 their habitat is more likely to be limited by changes in water temperature than flow rates.

11 Water temperatures in the Sacramento and Feather Rivers under Alternative 3 would not be  
12 different from those under Alternative 1A, Impact AQUA-149, which indicates that there would be  
13 no effect on temperatures in either river relative to Existing Conditions.

14 Water temperatures were not modeled for the San Joaquin River.

15 **NEPA Effects:** Collectively, these results indicate that this effect would not be adverse because it  
16 does not have the potential to substantially reduce the amount of suitable rearing habitat. Water  
17 temperature conditions in the Sacramento and Feather Rivers under Alternative 3 would not differ  
18 from those under the NEPA baseline during the white sturgeon juvenile rearing period.

19 **CEQA Conclusion:** In general, Alternative 3 would not affect the quantity and quality of white  
20 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

21 Water temperature was used to determine the potential impacts of Alternative 3 on white sturgeon  
22 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,  
23 their habitat is more likely to be limited by changes in water temperature than flow rates.

24 Water temperatures in the Sacramento and Feather rivers under Alternative 3 would not be  
25 different from those under Alternative 1A, which indicates that there would be no effect on  
26 temperatures in the Sacramento River relative to Existing Conditions, but temperatures would be  
27 higher than those under Existing Conditions during the majority of months in the Feather River.

28 Water temperatures were not modeled for the San Joaquin River.

#### 29 **Summary of CEQA Conclusion**

30 Collectively, the results of the Impact AQUA-149 CEQA analysis indicate that the difference between  
31 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
32 alternative could substantially reduce the availability of suitable migration habitat and interfere  
33 with the movement of fish, contrary to the NEPA conclusion set forth above. Water temperatures  
34 would be higher under Alternative 3 relative to Existing Conditions in Feather Rivers during the  
35 green sturgeon juvenile rearing period, but would be similar between Existing Conditions and  
36 Alternative 3 in the Sacramento River.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 3 indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on rearing habitat for green sturgeon. This impact is found to be less  
20 than significant and no mitigation is required.

#### 21 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

22 In general, the effects of Alternative 3 on white sturgeon migration conditions relative to NAA are  
23 uncertain.

24 Analyses for white sturgeon focused on the Sacramento River (north Delta to RM 143—i.e., Wilkins  
25 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number  
26 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)  
27 (Table 11-3-45). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A3\_LLТ were  
28 generally similar to those under NAA. The number of months per year above 31,000 cfs at Verona  
29 under A3\_LLТ would be up to 50% lower than under NAA. On an absolute scale, all of these changes  
30 would be negligible (up to 0.2 months).

1 **Table 11-3-45. Difference and Percent Difference in Number of Months in Which Flow Rates**  
2 **Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
<b>Wilkins Slough, 17,700 cfs<sup>a</sup></b>		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (5%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
<b>Wilkins Slough, 5,300 cfs<sup>b</sup></b>		
Wet	-0.1 (-2%)	0.1 (1%)
Above Normal	0 (0%)	0.3 (5%)
Below Normal	0.2 (4%)	0.5 (10%)
Dry	0.6 (11%)	0.3 (5%)
Critical	0.3 (10%)	0.3 (7%)
<b>Verona, 31,000 cfs<sup>a</sup></b>		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.1 (-5%)	0.1 (6%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.2 (-60%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Months analyzed: February through May.

<sup>b</sup> Months analyzed: November through May.

3  
4 Larval transport flows were also examined by utilizing the positive correlation between year class  
5 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the  
6 mechanism responsible for the relationship is that Delta outflow provides improved larval transport  
7 that results in improved year class strength. The percentage of months exceeding flow thresholds  
8 under A3\_LLT would generally be lower than those under NAA (up to 50% lower) (Table 11-3-46).  
9 These results suggest that, using the positive correlation between Delta outflow and year class  
10 strength, year class strength would be lower under Alternative 3.

1 **Table 11-3-46. Difference and Percent Difference in Percentage of Months in Which Average Delta**  
 2 **Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second in April and May**  
 3 **of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
<b>April</b>			
15,000 cfs	Wet	-15 (-16%)	-15 (-16%)
	Above Normal	-25 (-27%)	-25 (-27%)
20,000 cfs	Wet	-12 (-14%)	-12 (-14%)
	Above Normal	-33 (-44%)	-25 (-38%)
25,000 cfs	Wet	-15 (-19%)	-12 (-15%)
	Above Normal	-17 (-29%)	-8 (-17%)
<b>May</b>			
15,000 cfs	Wet	-15 (-17%)	-8 (-10%)
	Above Normal	-33 (-40%)	-8 (-14%)
20,000 cfs	Wet	-35 (-41%)	-12 (-19%)
	Above Normal	-25 (-60%)	-17 (-50%)
25,000 cfs	Wet	-31 (-44%)	-19 (-33%)
	Above Normal	-17 (-50%)	-8 (-33%)
<b>April/May Average</b>			
15,000 cfs	Wet	-15 (-16%)	-8 (-9%)
	Above Normal	-33 (-33%)	-25 (-27%)
20,000 cfs	Wet	-23 (-26%)	-19 (-23%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-25 (-50%)	-25 (-50%)

4  
 5 For juveniles, year-round migration flows at Verona would be up to 54% lower under A3\_LLT  
 6 relative to NAA during four of 12 months (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
 7 *Analysis*).

8 For adults, the average number of months per year during the November through May adult  
 9 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was  
 10 determined (Table 11-3-45). The average number of months exceeding 5,300 cfs under A3\_LLT  
 11 would always be similar to greater than the number of months under NAA.

12 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 3 and  
 13 NAA (Table 11-3-45). However, due to the removal of water at the north Delta intakes, there are  
 14 substantial differences in through-Delta flows between Alternative 3 and NAA (Table 11-5-46).  
 15 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between  
 16 year class strength and Delta outflow during April and May. However, this conclusion was reached in  
 17 the absence of north Delta intakes and the exact mechanism that causes this correlation is not  
 18 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper  
 19 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another  
 20 hypothesis suggests that the positive correlation is a result of higher flows through the Delta  
 21 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some

1 combination of these factors are working together to produce the positive correlation between high  
2 flows and sturgeon year-class strength.

3 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation  
4 between year class strength and river/Delta flow will be addressed through targeted research and  
5 monitoring to be conducted in the years leading up to the initiation of north Delta facilities  
6 operations. If these targeted investigations determine that the primary mechanisms behind the  
7 positive correlation between high flows and sturgeon year-class strength are related to upstream  
8 conditions, then Alternative 3 would be deemed Not Adverse due to the similarities in upstream  
9 flow conditions between Alternative 3 and NAA. However, if the targeted investigations lead to a  
10 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and  
11 through-Delta flow conditions, then Alternative 3 would be deemed adverse due to the magnitude of  
12 reductions in through-Delta flow conditions in Alternative 3 as compared to NAA.

13 **CEQA Conclusion:** In general, Alternative 3 would not affect white sturgeon migration conditions  
14 relative to Existing Conditions.

15 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough  
16 under A3\_LLT would generally be similar to or greater those under Existing Conditions, except in  
17 below normal years (25% lower) (Table 11-3-45). The number of months per year above 31,000 cfs  
18 at Verona under A3\_LLT would be similar to or up to 60% lower than the number under Existing  
19 Conditions.

20 For Delta outflow, the percent of months exceeding flow thresholds under A3\_LLT would  
21 consistently be lower than those under Existing Conditions for each flow threshold, water year type,  
22 and month (14% to 60% lower on a relative scale) (Table 11-3-46).

23 For juveniles, year-round migration flows at Verona would be up to 36% lower under A3\_LLT  
24 relative to Existing Conditions in four of 12 months (Appendix 11C, *CALSIM II Model Results utilized*  
25 *in the Fish Analysis*). Flows under A3\_LLT during other months are generally similar to or greater  
26 than flows under Existing Conditions.

27 For adult migration, the average number of months exceeding 5,300 cfs under A3\_LLT would  
28 generally be similar to the number of months under Existing Conditions (Table 11-3-45).

### 29 **Summary of CEQA Conclusion**

30 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between  
31 the Existing Conditions and Alternative 3 could be significant because, under the Existing  
32 Conditions, the alternative could substantially reduce the quality of suitable rearing habitat,  
33 contrary to the NEPA conclusion set forth above. The exceedance of flow thresholds in the  
34 Sacramento River and for Delta outflow would be lower under Alternative 3 than under the Existing  
35 Conditions, although there is high uncertainty that year class strength is due to Delta outflow or if  
36 both year class strength and Delta outflows are co-variable with another unknown factor. These  
37 reduced flows could have a substantial effect on the ability of sturgeon to migrate downstream,  
38 including delaying or slowing rates of successful migration downstream, and increasing the risk of  
39 mortality.

40 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
41 change, future water demands, and implementation of the alternative. The analysis described above  
42 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the

1 alternative from those of sea level rise, climate change and future water demands using the model  
2 simulation results presented in this chapter. However, the increment of change attributable to the  
3 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
4 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
5 implementation period, which does include future sea level rise, climate change, and water  
6 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
7 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
8 effect of the alternative from those of sea level rise, climate change, and water demands.

9 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
10 term implementation period and Alternative 3 indicates that flows in the locations and during the  
11 months analyzed above would generally be similar between Existing Conditions during the LLT and  
12 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
13 found above would generally be due to climate change, sea level rise, and future demand, and not  
14 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
15 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would  
16 not in itself result in a significant impact on migration habitat of white sturgeon. Additionally, as  
17 described above in the NEPA Effects statement, further investigation is needed to better understand  
18 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management  
19 would be used to make adjustments to meet the biological goals and objectives. This impact is found  
20 to be less than significant and no mitigation is required.

#### 21 **Restoration Measures (CM2, CM4–CM7, and CM10)**

22 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
23 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
24 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
25 restoration measures described for white sturgeon under Alternative 1A (Impact AQUA-151  
26 through AQUA-153) also appropriately characterize effects under Alternative 3.

27 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

#### 28 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

#### 29 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 30 **Sturgeon**

#### 31 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

32 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to  
33 white sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-152, the effects  
34 of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be  
35 adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

36 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or  
37 less than significant, and no mitigation is required.

#### 38 **Other Conservation Measures (CM12–CM19 and CM21)**

39 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
40 differences in other conservation-related fish effects are anticipated anywhere in the affected

1 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
2 effects of other conservation measures described for white sturgeon under Alternative 1A (Impact  
3 AQUA-154 through AQUA-162) also appropriately characterize effects under Alternative 3.

4 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

5 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

6 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**  
7 **(CM13)**

8 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

9 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**  
10 **(CM15)**

11 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

12 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

13 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

14 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

15 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**  
16 **Sturgeon (CM21)**

17 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
18 adverse effect, or beneficial effects on white sturgeon for the reasons identified for Alternative 1A.

19 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to  
20 less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A,  
21 and no mitigation is required.

22 **Pacific Lamprey**

23 **Construction and Maintenance of CM1**

24 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

25 The potential effects of construction of water conveyance facilities on Pacific lamprey under  
26 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-163) except  
27 that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the  
28 effects would be proportionally less under this alternative. This would convert about 4,450 lineal  
29 feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of  
30 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
31 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
32 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
33 contaminated sediments would be similar to Alternative 1A and the same environmental  
34 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in

1 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
2 effects.

3 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and  
4 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
5 not be adverse for Pacific lamprey

6 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-163, the impact of the construction  
7 of water conveyance facilities on Pacific lamprey would be less than significant except for  
8 construction noise associated with pile driving which would only occur for two intakes rather than  
9 five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would  
10 reduce that noise impact to less than significant.

11 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
12 **of Pile Driving and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
14 Alternative 1A.

15 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
16 **and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
18 Alternative 1A.

19 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

20 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
21 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-164) except  
22 that only two intakes would be maintained under Alternative 3 rather than five as under Alternative  
23 1A. As concluded in Alternative 1A, Impact AQUA-164, the effect would not be adverse for Pacific  
24 lamprey.

25 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance  
26 of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation  
27 would be required.

28 **Water Operations of CM1**

29 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

30 The potential entrainment impacts of Alternative 3 on Pacific lamprey would be similar but less than  
31 those described above for Alternative 1A for operating new SWP/CVP north Delta intakes (Impact  
32 AQUA-165), non-physical barriers at the entrances to Clifton Court Forebay and the Delta Mendota  
33 Canal (Impact AQUA-3), and decommissioning agricultural diversions in ROAs (Impact AQUA-3).

34 Under Alternative 3, average annual entrainment of Pacific lamprey at the south Delta export  
35 facilities, as estimated by salvage density, would be reduced by 25% (834 fish) (Table 11-3-47)  
36 across all water year types compared to NAA. Therefore, Alternative 3 would not have adverse  
37 effects on Pacific lamprey and may be beneficial because of the potential reduction of entrainment at  
38 Delta water export facilities.

**Predation Associated with Entrainment**

Lamprey predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Average pre-screen predation loss for fish entrained at the south Delta is 75% at Clifton Court Forebay and 15% at the CVP. Lamprey entrainment to the south Delta would be reduced by 25% compared to NAA and predation losses would be expected to be reduced at a similar proportion. The impact and conclusion for predation risk associated with NPB structures would be the same as described for Alternative 1A.

Predation at the north Delta would be increased due to the construction of the proposed water export facilities on the Sacramento River. The effect on lamprey from predation loss at the north Delta is unknown because of the lack of knowledge about their distribution and population abundances in the Delta.

**NEPA Effects:** The overall effect of entrainment and predation on lamprey from Alternative 3 is considered not adverse, for the reason describe for Alternative 1A.

**CEQA Conclusion:** As described above, annual entrainment losses of Pacific lamprey would be decreased under Alternative 3 (A3\_LLТ) relative to Existing Conditions by 28% (939 fish).

Impacts of water operations on entrainment of Pacific lamprey are expected to be less than significant, and no mitigation would be required.

**Table 11-3-47. Pacific Lamprey Annual Entrainment Index<sup>a</sup> at the SWP and CVP Salvage Facilities for Alternative 3**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LLТ	NAA vs. A3_LLТ
All Years	-939 (-28%)	-834 (-25%)
Shading indicates entrainment increased 10% or more.		

<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.

The impact and conclusion for predation associated with entrainment would be about the same as described above because the additional predation losses associated with the proposed north Delta intakes would be offset by the reduction in predation loss at the south Delta. The relative impact of predation loss on the lamprey population is unknown because there is little available knowledge on their distribution and abundance in the Delta. The impact would be less than significant. No mitigation would be required.

**Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for Pacific Lamprey**

In general, Alternative 3 would reduce the quantity and quality of Pacific lamprey spawning habitat relative to NAA.

Flow-related effects on Pacific lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd dewatering risk and effects of water temperature. Rapid reductions in flow can dewater redds leading to mortality. Dewatering risk was analyzed for the Sacramento River at Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at

1 Thermalito Afterbay, and American River at Nimbus Dam and at the confluence with the Sacramento  
 2 River. Pacific lamprey spawn in these rivers between January and August. Dewatering risk to redd  
 3 cohorts was characterized by the number of cohorts experiencing a month-over-month reduction in  
 4 flows (using CALSIM II outputs) of greater than 50%. Water temperature results from the SRWQM  
 5 and the Reclamation Temperature Model were used to assess the exceedances of water  
 6 temperatures under all model scenarios in the upper Sacramento, Trinity, Feather, and American  
 7 Rivers.

8 Flows in all rivers evaluated indicate negligible effects (<5%) or an increase in redd cohorts exposed  
 9 to month-over-month flow reductions between January and August for Alternative 3 compared to  
 10 NAA, indicates project-related increases would only occur in the Feather River, which would consist  
 11 of a 40% increase in dewatering risk. (Table 11-3-48). Project-related effects in all other locations  
 12 analyzed consist of negligible effects (<5%) that would not have biologically meaningful effects or  
 13 decreases in dewatering risk (to -21% in the Sacramento River) that would have beneficial effects  
 14 on spawning success.

15 **Table 11-3-48. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**  
 16 **Cohorts<sup>a</sup>**

Location	Comparison <sup>b</sup>	EXISTING CONDITIONS	
		vs. A3_LL1	NAA vs. A3_LL1
Sacramento River at Keswick	Difference	11	-11
	Percent Difference	20%	-14%
Sacramento River at Red Bluff	Difference	3	-15
	Percent Difference	6%	-21%
Trinity River downstream of Lewiston	Difference	1	1
	Percent Difference	1%	1%
Feather River at Thermalito Afterbay	Difference	1	43
	Percent Difference	1%	40%
American River at Nimbus Dam	Difference	33	-4
	Percent Difference	39%	-3%
American River at Sacramento River confluence	Difference	42	2
	Percent Difference	44%	3%

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

<sup>b</sup> Positive values indicate a higher value in Alternative 3 than under the baseline (EXISTING CONDITIONS or NAA).

17  
 18 For evaluation of effects of Alternative 3 on water temperatures, it was determined that the effects  
 19 of Alternative 3 on water temperatures for the Sacramento River, Trinity River, and the American  
 20 River would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166  
 21 indicate that egg exposure would be similar to NAA at most locations, although egg exposure would  
 22 substantially increase in the Feather River below Thermalito Afterbay.

23 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the  
 24 potential to substantially reduce suitable spawning habitat and substantially reduce the number of  
 25 fish as a result of egg mortality. There would be increases in egg cohorts (exposed to redd

1 dewatering risk (43 cohorts or 40%) and temperatures greater than 71.6°F (84 cohorts or 91%) in  
2 the Feather River below Thermalito Afterbay. Increased redd dewatering risk and exposure risk to  
3 egg cohorts below Thermalito Afterbay would reduce spawning success there. This effect is a result  
4 of the specific reservoir operations and resulting flows associated with this alternative. Applying  
5 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to  
6 reduce this effect to a level that is not adverse would fundamentally change the alternative, thereby  
7 making it a different alternative than that which has been modeled and analyzed. As a result, this  
8 would be an unavoidable adverse effect. Even so, proposed mitigation (Mitigation Measure AQUA-  
9 166a through AQUA-166c) has the potential to reduce the severity of impact, although not  
10 necessarily to a not adverse level.

11 **CEQA Conclusion:** In general, Alternative 3 would reduce the quantity and quality of Pacific lamprey  
12 spawning habitat relative to the Existing Conditions.

13 Rapid reductions in flow can dewater redds leading to mortality. Predicted effects of Alternative 3 in  
14 the Sacramento River and American River are for increases in the number of redd cohorts predicted  
15 to experience a month-over-month change in flow of greater than 50% relative to Existing  
16 Conditions (Table 11-3-48). Changes would be most substantial for the American River, with  
17 increased risk of dewatering exposure to 33 cohorts or 39% at Nimbus Dam, and 42 cohorts or 44%  
18 at the confluence. Effects of Alternative 3 would be negligible (<5%) for the Trinity River and  
19 Feather River.

20 For evaluation of effects of Alternative 3 on water temperatures, it was determined that the effects  
21 of Alternative 3 on water temperatures for the Sacramento River, Trinity River, Feather River, and  
22 the American River would be similar to those described for Alternative 1A. Results from Alternative  
23 1A, Impact AQUA-166 indicate that egg exposure would be greater than under Existing Conditions at  
24 the Sacramento, Feather, and American Rivers.

### 25 **Summary of CEQA Conclusion**

26 Collectively, these results indicate that the impact would be significant because it has the potential  
27 to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a  
28 result of egg mortality. Effects of Alternative 3 on Pacific lamprey redd dewatering risk would be  
29 biologically meaningful in the Sacramento River (based on 20% increase in exposure risk) and the  
30 American River (based on a maximum of 44% increase in exposure risk) and would not have  
31 significant effects on dewatering risk in the Feather River and Trinity River. In addition, egg  
32 exposure to elevated temperatures would be greater than that under Existing Conditions at the  
33 Sacramento, Feather, and American Rivers.

34 This impact is a result of the specific reservoir operations and resulting flows associated with this  
35 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to  
36 the extent necessary to reduce this impact to a less-than-significant level would fundamentally  
37 change the alternative, thereby making it a different alternative than that which has been modeled  
38 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible  
39 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the  
40 severity of impact though not necessarily to a less-than-significant level.

1       **Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional**  
2       **Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of**  
3       **Mitigation to Reduce Impacts to Spawning Habitat**

4       Although analysis conducted as part of the EIR/EIS determined that Alternative 3 would have  
5       significant and unavoidable adverse effects on spawning habitat, this conclusion was based on  
6       the best available scientific information at the time and may prove to have been overstated.  
7       Upon the commencement of operations of CM1 and continuing through the life of the permit, the  
8       BDCP proponents will monitor effects on spawning habitat in order to determine whether such  
9       effects would be as extensive as concluded at the time of preparation of this document and to  
10      determine any potentially feasible means of reducing the severity of such effects. This mitigation  
11      measure requires a series of actions to accomplish these purposes, consistent with the  
12      operational framework for Alternative 3.

13      The development and implementation of any mitigation actions shall be focused on those  
14      incremental effects attributable to implementation of Alternative 3 operations only.  
15      Development of mitigation actions for the incremental impact on spawning habitat attributable  
16      to climate change/sea level rise are not required because these changed conditions would occur  
17      with or without implementation of Alternative 3.

18      **Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts**  
19      **on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1**

20      Following commencement of initial operations of CM1 and continuing through the life of the  
21      permit, the BDCP proponents will conduct additional evaluations to define the extent to which  
22      modified operations could reduce impacts to spawning habitat under Alternative 3. The analysis  
23      required under this measure may be conducted as a part of the Adaptive Management and  
24      Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25      **Mitigation Measure AQUA-166c: Consult with NMFS, USFWS, and CDFW to Identify and**  
26      **Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning**  
27      **Habitat Consistent with CM1**

28      In order to determine the feasibility of reducing the effects of CM1 operations on Pacific lamprey  
29      habitat, the BDCP proponents will consult with NMFS, USFWS and CDFW to identify and  
30      implement any feasible operational means to minimize effects on spawning habitat. Any such  
31      action will be developed in conjunction with the ongoing monitoring and evaluation of habitat  
32      conditions required by Mitigation Measure AQUA-166a.

33      If feasible means are identified to reduce impacts on spawning habitat consistent with the  
34      overall operational framework of Alternative 3 without causing new significant adverse impacts  
35      on other covered species, such means shall be implemented. If sufficient operational flexibility  
36      to reduce effects on Pacific lamprey habitat is not feasible under Alternative 3 operations,  
37      achieving further impact reduction pursuant to this mitigation measure would not be feasible  
38      under this Alternative, and the impact on Pacific lamprey would remain significant and  
39      unavoidable.

**Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

In general, effects of Alternative 3 on flow would be negligible relative to NAA.

Flow-related impacts on Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk and effects of water temperatures. Ammocoete stranding risk was analyzed for the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus Dam and at the confluence with the Sacramento River. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. The analysis of ammocoete stranding was conducted by analyzing a range of month-over-month flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort was considered stranded if at least one month-over-month flow reduction was greater than the flow reduction at any time during the period.

Effects of Alternative 3 on Pacific lamprey ammocoete stranding were analyzed by calculating month-over-month flow reductions for the Sacramento River at Keswick for January through August (Table 11-3-49). Results indicate primarily no effect (0%) compared to NAA, with the exception of a small increase (7%) in 65% flow reductions that would not have biologically meaningful effects on stranding conditions and a small decrease (-9%) in 80% flow reduction exposures that would have a small, beneficial effect. These results indicate that Alternative 3 would not have biologically meaningful effects on Pacific lamprey ammocoete stranding conditions at Keswick.

**Table 11-3-49. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LL1	NAA vs. A3_LL1
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	7
-70%	4	0
-75%	1	0
-80%	9	-9
-85%	4	0
-90%	NA	NA

NA = all values were 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

Results of comparisons for the Sacramento River at Red Bluff provide similar conclusions, with slightly more variability in results (Table 11-3-50). Results for Alternative 3 compared to NAA indicate no change (0%), negligible to small increases (to 5%) that would not have biologically meaningful effects on stranding conditions, and small decreases (to -9%) that would have a small, beneficial effect on stranding conditions. These results indicate that Alternative 3 would not have biologically meaningful effects on Pacific lamprey ammocoete stranding conditions at Red Bluff.

1 **Table 11-3-50. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 3 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLТ	NAA vs. A3_LLТ
-50%	0	0
-55%	4	0
-60%	7	5
-65%	-2	-3
-70%	9	-2
-75%	0	-9
-80%	5	-7
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

4  
 5 Comparisons for the Trinity River no effect (0%) or negligible changes (<5%) attributable to the  
 6 project under Alternative 3 relative to NAA (Table 11-3-51). These results indicate that Alternative 3  
 7 would not have biologically meaningful effects on Pacific lamprey ammocoete stranding conditions  
 8 in the Trinity River.

9 **Table 11-3-51. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLТ	NAA vs. A3_LLТ
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	21	-3
-80%	26	-1
-85%	16	-1
-90%	34	-1

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

11  
 12 Comparisons for the Feather River indicate no difference (0%) or negligible project-related effects  
 13 (<5%) for flow reductions up to 80%, and substantial decreases in cohorts exposed to 85% flow  
 14 reductions (-42%) and 90% flow reductions (-28%) under Alternative 3, compared to NAA. This  
 15 would have a beneficial effect on spawning success. (Table 11-3-52). These results indicate that  
 16 Alternative 3 would not have biologically meaningful effects on Pacific lamprey ammocoete  
 17 stranding conditions in the Feather River.

1 **Table 11-3-52. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
 3 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-1	1
-85%	-24	-42
-90%	-64	-28

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

4  
 5 Comparisons for the American River at Nimbus Dam (Table 11-3-53) indicate negligible effects  
 6 (<5%) for most flow reduction categories, a small increase (8%) in cohorts exposed to 90% flow  
 7 reductions, and small decreases (to -15%) in cohorts exposed to 70%, 80%, and 85% flow  
 8 reductions for Alternative 3 compared to NAA. These results would have a beneficial effect on  
 9 spawning success, and Alternative 3 would not have biologically meaningful effects on Pacific  
 10 lamprey ammocoete stranding conditions in the American River at Nimbus Dam.

11 **Table 11-3-53. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
 13 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	2	0
-70%	27	-9
-75%	80	-6
-80%	264	-4
-85%	332	-15
-90%	225	8

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

14  
 15 Comparisons for the American River at the confluence with the Sacramento River (Table 11-3-54)  
 16 (A3\_LLT compared to NAA) indicates negligible effects (<5%) on cohort exposure for all flow  
 17 reduction categories. These results indicate that Alternative 3 would not have biologically

1 meaningful effects on Pacific lamprey ammocoete stranding conditions in the American River at the  
2 confluence with the Sacramento River.

3 **Table 11-3-54. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
4 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
5 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LL1	NAA vs. A3_LL1
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	4	-4
-75%	41	3
-80%	198	1
-85%	250	0
-90%	339	5

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

6

7 Because water temperatures under Alternative 3 would be similar to those under Alternative 1A,  
8 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 3 would be  
9 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there  
10 would be small to moderate increases and decreases in exposure relative to NAA that will balance  
11 out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

12 **NEPA Effects:** Collectively these results indicate that effects would not be adverse because they  
13 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result  
14 of ammocoete mortality. Alternative 3 would generally cause no effect (0%), negligible effects  
15 (<5%), isolated categories of flow reductions that would experience a small increase in cohort  
16 exposure but that would not have biologically meaningful adverse effects, or small decreases in  
17 stranding risk that would have beneficial effects. There would also be small, beneficial effects in the  
18 Sacramento River (decreased occurrence of month-over-month flow reductions to -12%) and more  
19 substantial beneficial effects in the Feather River (up to -15% in exposures to 70%, 80%, and 85%  
20 flow reductions) due to project-related effects of Alternative 3. There would be small to moderate  
21 increases and decreases in ammocoete exposure to elevated water temperatures relative to Existing  
22 Conditions that will balance out within rivers such that there would be no overall effect on Pacific  
23 lamprey ammocoetes.

24 **CEQA Conclusion:** In general, under Alternative 3 water operations, the quantity and quality of  
25 Pacific lamprey rearing habitat would not be affected relative to the CEQA baseline.

26 Comparisons of month-over-month flow reductions under Alternative 3 relative to Existing  
27 Conditions for the Sacramento River at Keswick indicate negligible changes (<5%) in occurrence of  
28 cohort exposure for all flow reduction categories with the exception of a small increase in exposure  
29 (9%) in the 80% flow reduction category (Table 11-3-49). These results indicate that effects of  
30 Alternative 3 on flow would not have biologically meaningful effects on Pacific lamprey ammocoete  
31 stranding risk in the Sacramento River at Keswick.

1 Comparisons of Alternative 3 to Existing Conditions for the Sacramento River at Red Bluff indicate  
2 negligible changes (<5%) in occurrence of cohort exposure for all flow reduction categories with the  
3 exception of small increases in exposure in the 60% (increase of 7%), 70% (increase of 9%), and  
4 80% (increase of 5%) flow reduction categories, and a more substantial increase in the 90% flow  
5 reduction category (100% or from 56 to 112 cohorts exposed) (Table 11-3-49). These results  
6 indicate that effects of Alternative 3 on flow would cause increased risk of Pacific lamprey  
7 ammocoete stranding in the Sacramento River at Red Bluff but not to the extent that would be  
8 considered a biologically meaningful effect.

9 In the Trinity River, Alternative 3 would have no effect on cohort exposure for the lower flow  
10 reduction categories, and would cause moderate increases in cohort exposure (to 34%) for flow  
11 reductions from 75% to 90% (Table 11-3-51). The effects of Alternative 3 on flow reduction  
12 exposures are consistent for the higher flow reduction categories but of relatively small magnitude  
13 and therefore effects would not have biologically meaningful effects on rearing success.

14 In the Feather River, Alternative 3 would have no effect (0% difference) or negligible effects (<5%)  
15 on cohort exposure for the lower flow reduction categories, and would have a moderate increase in  
16 cohort exposure (24%) to flow reductions of 85% and a more substantial increase (64%) in  
17 exposures to flow reductions of 90% (Table 11-3-52). Based on the fact that moderate to substantial  
18 increases in cohort exposure would only occur for the two highest flow reduction categories, these  
19 results indicate that effects of Alternative 3 on flow would not have biologically meaningful effects  
20 on rearing success.

21 Comparisons for the American River at Nimbus Dam (Table 11-3-53) and at the confluence with the  
22 Sacramento River (Table 11-3-54) predict increased occurrence of cohort exposures under A3\_LL  
23 relative to Existing Conditions for 70% through 90% flow reduction events; predicted increases  
24 ranged from 27 to 332% for Nimbus Dam (increase from 56 to 252 cohorts exposed) and from 41 to  
25 339% (increase from 56 to 246 cohorts exposed) for the confluence. These are substantial increases  
26 in cohort stranding exposure that would have negative effects on rearing success.

27 Because water temperatures under Alternative 3 would be similar to those under Alternative 1A,  
28 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 3 would be  
29 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there  
30 would be substantial increases in ammocoete exposure in all rivers relative to Existing Conditions.

### 31 **Summary of CEQA Conclusion**

32 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between  
33 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
34 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
35 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Alternative 3  
36 would have biologically meaningful effects in the American River at Nimbus Dam and at the  
37 confluence with the Sacramento River based on substantial increases in the number of cohorts  
38 exposed to stranding risk due to flow reductions in each of the higher flow reduction categories  
39 (increases ranging from 27 to 332% for Nimbus Dam and from 41 to 339% for the confluence).  
40 Alternative 3 would not affect ammocoete stranding risk in the Sacramento River, Trinity River, and  
41 the Feather River (based on negligible effects, reduced occurrence of flow reduction events, or  
42 moderate increases in risk, to 34%, and/or more substantial but isolated increases in risk, to 64%,  
43 that would not have biologically meaningful effects). There would be substantial increases in  
44 ammocoete exposure to increased temperatures in all rivers evaluated.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 3 indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less  
20 than significant and no mitigation is required.

#### 21 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

22 In general, effects of Alternative 3 on Pacific lamprey migration conditions would be negligible  
23 relative to NAA.

#### 24 ***Macrophthalmia***

25 After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macrophthalmia once  
26 they reach the Delta. Migration generally is associated with large flow pulses in winter months  
27 (December through March) (U.S. Fish and Wildlife Service unpublished data) meaning alterations in  
28 flow have the potential to affect downstream migration conditions. The effects of Alternative 3 on  
29 seasonal migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow  
30 output. Flow rates along the migration pathways of Pacific lamprey during the likely outmigration  
31 period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff,  
32 the Feather River at the confluence with the Sacramento River, and the American River at the  
33 confluence with the Sacramento River.

#### 34 ***Sacramento River***

35 Effects of Alternative 3 on mean monthly flow rates for the Sacramento River at Rio Vista (Appendix  
36 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May compared to NAA  
37 would be primarily negligible effects (<5%) or decreases in flow to -15%, with small increases in  
38 flow during December in dry years (7%) and during May in dry years (8%). Meaningful (>5%)  
39 project-related reductions in flow would occur in drier water years (when effects on migration  
40 would be more critical) during January (-10% in critical years), March (below normal and dry years  
41 to -13%), and April (-6% in below normal years). These project-related decreases in flow are  
42 relatively infrequent during the migration period and of small magnitude and would not have  
43 biologically meaningful effects on macrophthalmia migration success.

1 For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
2 *Analysis*), the difference in mean monthly flow rate for Alternative 3 compared to NAA for the  
3 December through May migration period indicates primarily negligible effects (<5%) or increases in  
4 flow to 15%, which would have a beneficial effect on migration conditions, and only a single  
5 occurrence of a small, project-related reduction in flow (-8%) during January in critical years. These  
6 results indicate that the effects of Alternative 3 on flow would not have biologically meaningful  
7 effects on outmigrating macrophthalmia at this location.

#### 8 *Feather River*

9 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,  
10 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate negligible project-  
11 related effects (<5%) or increases in flow to 42% which would have beneficial effects on migration  
12 conditions, with the exception of a single, project-related decreases in flow during January in critical  
13 years (-9%). Based on the predominance of negligible effects and/or increases in flow that would be  
14 beneficial for migration, this alternative would not have negative effects on macrophthalmia  
15 migration in the Feather River at the confluence, compared to NAA.

#### 16 *American River*

17 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,  
18 *CALSIM II Model Results utilized in the Fish Analysis*) for December through May (A3\_LLT compared  
19 to NAA) indicates project-related effects consist primarily of negligible effects (<5%), with small to  
20 moderate increases in flow (to 36%) during some months/water years that would be beneficial for  
21 migration, and with small decreases in flow (to -9%) predicted to occur during March in dry and  
22 critical years. These isolated, small decreases in flow would not have biologically meaningful effects  
23 on outmigrating macrophthalmia in the American River. These results indicate that Alternative 3  
24 would not have biologically meaningful effects on macrophthalmia migration in the American River.

25 Overall, flow-related effects of Alternative 3 on outmigrating macrophthalmia are not biologically  
26 meaningful in any of the rivers analyzed. Effects on flow would consist of negligible effects (<5%),  
27 small to moderate increases in flow that would have a beneficial effect on migration conditions, or  
28 infrequent and relatively small decreases in flow which would not have biologically meaningful  
29 effects on Pacific lamprey macrophthalmia migration in the rivers analyzed.

### 30 **Adults**

#### 31 *Sacramento River*

32 For the Sacramento River at Red Bluff for the time-frame January to June (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*), effects of Alternative 3 on mean monthly flow consist  
34 primarily of negligible effects (<5%) or infrequent, small increases in flow (to 13%) and a single  
35 occurrence of a small decrease in flow (-8%) during January in critical years. These results indicate  
36 that effects of Alternative 3 on flow would not have biologically meaningful effects on adult  
37 migration in the Sacramento River, relative to NAA.

#### 38 *Feather River*

39 For the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model*  
40 *Results utilized in the Fish Analysis*) during January to June, mean monthly flows under Alternative 3  
41 would be similar to (<5% difference) or greater than (to 32%) flows under NAA, for most months

1 and water year types, with the exception of small decreases in flow during January in critical years (-  
2 9%) and during June in critical years (-8%). The predominance of increases in flow would have  
3 beneficial effects on migration conditions, and the few, small decreases would not have biologically  
4 meaningful effects on migration conditions. These results indicate that effects of Alternative 3 on  
5 flow would not have biologically meaningful effects on adult migration conditions in the Feather  
6 River, relative to NAA.

#### 7 *American River*

8 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
9 River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
10 (A3\_LLT compared to NAA) indicates predominantly negligible effects (<5%) or increases in flow (to  
11 36%) attributable to the project with the exception of small decreases in flow during March in dry  
12 (-7%) and critical (-9%) years. The predominance of increases in flow would have beneficial effects  
13 on migration conditions and the few, small decreases would not have biologically meaningful effects  
14 on migration conditions. These results indicate that effects of Alternative 3 on flow would not have  
15 biologically meaningful effects on adult migration conditions in the American River, relative to NAA.

16 Overall, these results indicate that project-related effects of Alternative 3 on mean monthly flows  
17 during the Pacific lamprey adult migration period would consist of negligible effects (<5%) or  
18 increases in flow (up to 36%) that would have beneficial effects on migration conditions, with a few  
19 isolated, small decreases that would not have biologically meaningful effects on migration  
20 conditions.

21 **NEPA Effects:** Collectively, these results indicate that the effect of Alternative 3 on Pacific lamprey  
22 macrophthalmia and adult migration is not adverse because it would not substantially reduce rearing  
23 habitat or substantially reduce the number of fish as a result of ammocoete mortality. There would  
24 be no biologically meaningful effects of Alternative 3 on flows in any river evaluated during the  
25 Pacific lamprey macrophthalmia and adult migration periods.

26 **CEQA Conclusion:** In general, Alternative 3 would not affect the quantity and quality of Pacific  
27 lamprey migration habitat relative to the CEQA baseline.

#### 28 **Macrophthalmia**

##### 29 *Sacramento River*

30 Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista (Appendix 11C,  
31 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 3 relative  
32 to Existing Conditions indicate primarily negligible effects (<5%), or reductions in flow ranging from  
33 -5% to -36%. Effects in drier water year types when flow reductions would be most critical for  
34 migration conditions consist of negligible effects or small decreases (to -10%) that would not have  
35 biologically meaningful effects on migration conditions in all months during the migration period.  
36 These results indicate that Alternative 3 would not affect Pacific lamprey macrophthalmia migration  
37 conditions in the Sacramento River at Rio Vista.

38 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*  
39 *in the Fish Analysis*) for December to May indicate negligible (<5%) effects or increases in flow (to  
40 19%) for Alternative 3 relative to Existing Conditions for all months and water years, which would  
41 have beneficial effects on migration conditions, with the exception of a small decrease in flow  
42 (-14%) during May in wet years when it would not negatively affect migration conditions. These

1 results indicate that effects of Alternative 3 on flow would not have biologically meaningful effects  
2 on outmigrating macrophthmia in the Sacramento River at Red Bluff.

### 3 *Feather River*

4 Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized*  
5 *in the Fish Analysis*) for December to May indicate effects of Alternative 3 compared to Existing  
6 Conditions consist of negligible effects (<5%) or increases in flow (to 38%) that would have  
7 beneficial effects on migration conditions, with the exception of small decreases in flow during  
8 January in below normal years (-10%) and during March in below normal years (-12%), and a  
9 slightly larger reduction during May in wet years (-24%) when effects of flow reductions on  
10 migration conditions would be less critical. Flow reductions would be infrequent, of small  
11 magnitude, and of the greatest magnitude during wet years and therefore would not have  
12 biologically meaningful negative effects. These results indicate that the effects of Alternative 3 on  
13 flow would not have negative effects on outmigrating macrophthmia in the Feather River.

### 14 *American River*

15 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,  
16 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable results  
17 depending on the specific month and water year, with negligible effects (<5%) or decreases in flow  
18 (to -22%) during December, increases in wetter water years (to 28%) and decreases in drier water  
19 years (to -17%) during January through March, negligible effects (<5)% and small-scale increases or  
20 decreases (to -8%) during April, and reductions in flow (to -27%) during May in all but dry years  
21 (increase of 20%). Based on small to moderate reductions in flow (to -22%) in drier water years  
22 during most of the migration period (December through March and May), the effects of Alternative 3  
23 on flow would affect conditions for outmigrating macrophthmia in the American River at the  
24 confluence.

25 Overall, flow-related effects of Alternative 3 on outmigrating macrophthmia are not biologically  
26 meaningful in the Sacramento River and Feather River (based on negligible effects on flow, increases  
27 in flow that would have beneficial effects, and isolated and/or small magnitude decreases in flow  
28 that would not have negative effects on migration conditions), but would cause negative effects on  
29 migration conditions in the American river (based on small to moderate flow reductions for most of  
30 the migration period).

### 31 **Adults**

#### 32 *Sacramento River*

33 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*  
34 *Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from  
35 January through June indicate primarily negligible effects (<5%) or increases in flow (to 20%) that  
36 would have a beneficial effect on migration conditions, with the exception of a small decrease in  
37 mean monthly flow in May during wet years (-14%) when effects of flow reductions on migration  
38 conditions would be less critical. These results indicate that Alternative 3 would not have  
39 biologically meaningful effects on migration conditions in the Sacramento River at Red Bluff.

1 *Feather River*

2 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento  
3 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
4 indicate effects of Alternative 3 consist primarily of negligible effects (<5%) or increases in flow (to  
5 27%) that would have beneficial effects on migration, with the exception of small decreases (to -  
6 12%) during January and March in below normal years that would not have biologically meaningful  
7 effects on migration conditions, a moderate reduction (-24%) during May in wet years when effects  
8 of flow reductions would be less critical for migration, and more prevalent reductions (to -20% in  
9 wet, dry and critical years) during June which is late in the migration period. Based on these results,  
10 effects of Alternative 3 on flow would not have biologically meaningful negative effects on adult  
11 migration conditions in the Feather River.

12 *American River*

13 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
14 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
15 indicate variable effects of Alternative 3 depending on the month and water year type, with  
16 negligible effects (<5%) or increases in flow (to 28%) in wetter water years and decreases (to -17%)  
17 in drier water years for January through March, negligible effects or small increases or decreases in  
18 flow (to 8%) during April, reductions in flow (to -27%) in all but dry years (increase of 20%) during  
19 May and decreases in wet (-28%) and critical years (-45%) in June with increases (to 33%) in above  
20 and below normal years. Small to moderate flow reductions would occur in drier years during most  
21 of the migration period, with the most substantial reductions occurring during January, May, and  
22 June (the onset and end of the migration period), Alternative 3 would affect adult migration  
23 conditions in the American River.

24 Overall, effects of Alternative 3 on adult Pacific lamprey migration conditions consist of negligible  
25 effects on flow (<5%), increases in flow that would be beneficial for migration conditions, and  
26 infrequent and/or small decreases in flow that would not have biologically meaningful negative  
27 effects in the rivers analyzed. There would be more substantial reductions in flow under Alternative  
28 3 in the Feather River and the American River; however, based on the prevalence and magnitude of  
29 the effects, and the fact that the largest flow reductions would occur late in the migration period  
30 (June), it is concluded that effects of Alternative 3 on flow would not have biologically meaningful  
31 effects on migration conditions in these locations.

32 **Summary of CEQA Conclusion**

33 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between  
34 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
35 alternative could substantially reduce the amount of suitable habitat and substantially interfere with  
36 the movement of fish, contrary to the NEPA conclusion set forth above. Alternative 3 would affect  
37 outmigrating macrophthalmia and adult migration conditions in the American River (based on  
38 moderate flow reductions in drier years, to 22% for juvenile migration and to -45% for adult  
39 migration) during most months in the respective migration periods. Alternative 3 would not affect  
40 outmigrating macrophthalmia or migrating adults in the Sacramento River and the Feather River  
41 (based on negligible effects on flow, increases in flow, to 38%, that would have beneficial effects, and  
42 decreases in flow in wet years, to -36%, or as isolated, -20%, and/or small magnitude, to -12%,  
43 decreases in flow in drier water years that would not have negative effects on migration conditions).

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 3 indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on Pacific lamprey macrophthalmia and adult migration habitat. This  
20 impact is found to be less than significant and no mitigation is required.

#### 21 **Restoration Measures (CM2, CM4–CM7, and CM10)**

22 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
23 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
24 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
25 restoration measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169  
26 through AQUA-171) also appropriately characterize effects under Alternative 3.

27 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

#### 28 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

#### 29 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific 30 Lamprey**

#### 31 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

32 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to  
33 Pacific lamprey, and most would be at least slightly beneficial.

34 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or  
35 less than significant, and no mitigation is required.

#### 36 **Other Conservation Measures (CM12–CM19 and CM21)**

37 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
38 differences in other conservation-related fish effects are anticipated anywhere in the affected  
39 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish

1 effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impact  
2 AQUA-172 through AQUA-180) also appropriately characterize effects under Alternative 3.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

4 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

5 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**  
6 **(CM13)**

7 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

8 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**  
9 **(CM15)**

10 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

11 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

12 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

13 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

14 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
15 **Lamprey (CM21)**

16 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no  
17 adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified  
18 for Alternative 1A.

19 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to  
20 less than significant, or beneficial on Pacific lamprey, for the reasons identified for Alternative 1A,  
21 and no mitigation is required.

22 **River Lamprey**

23 **Construction and Maintenance of CM1**

24 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

25 The potential effects of construction of water conveyance facilities on river lamprey under  
26 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-181) except  
27 that Alternative 3 would include two intakes compared to five intakes under Alternative 1A, so the  
28 effects would be proportionally less under this alternative. This would convert about 4,450 lineal  
29 feet of existing shoreline habitat into intake facility structures and would require about 10.2 acres of  
30 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
31 shoreline and would require 27.3 acres of dredging. The effects related to temporary increases in  
32 turbidity, accidental spills, underwater noise, in-water work activities, and disturbance of  
33 contaminated sediments would be similar to Alternative 1A and the same environmental  
34 commitments and mitigation measures (described under Impact AQUA-1 for delta smelt and in

1 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential  
2 effects.

3 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and  
4 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
5 not be adverse for river lamprey

6 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-181, the impact of the construction  
7 of water conveyance facilities on river lamprey would be less than significant except for  
8 construction noise associated with pile driving. Potential pile driving impacts would be less than  
9 Alternative 1A because only two intakes would be constructed rather than five. Implementation of  
10 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
11 less than significant.

12 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
13 **of Pile Driving and Other Construction-Related Underwater Noise**

14 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
15 Alternative 1A.

16 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
17 **and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
19 Alternative 1A.

20 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

21 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
22 Alternative 3 would be similar to those described for Alternative 1A (see Impact AQUA-182) except  
23 that only two intakes would need to be maintained under Alternative 3 rather than five as under  
24 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-182, the impact would not be adverse  
25 for river lamprey.

26 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance  
27 of water conveyance facilities on river lamprey would be less than significant and no mitigation  
28 would be required.

29 **Water Operations of CM1**

30 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

31 The potential entrainment impacts of Alternative 3 on river lamprey would be proportionally  
32 similar to those described for Alternative 1A for operating new SWP/CVP north Delta intakes  
33 (Impact AQUA-183), non-physical barriers at the entrances to Clifton Court Forebay and the Delta  
34 Mendota Canal (Impact AQUA-183), and decommissioning agricultural diversions in ROAs (Impact  
35 AQUA-183). These actions would minimize or reduce potential entrainment.

36 **NEPA Effects:** Under Alternative 3, average annual entrainment of lamprey at the south Delta export  
37 facilities, as estimated by salvage density, would be reduced by 25% (834 fish) (Table 11-3-55)

1 across all water year types compared to NAA. Therefore, Alternative 3 would not have adverse  
2 effects on lamprey.

3 **Table 11-3-55. Lamprey Annual Entrainment Index<sup>a</sup> at the SWP and CVP Salvage Facilities - for**  
4 **Alternative 3**

Water Year Types	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A3_LL1	NAA vs. A3_LL1
All Years	-939 (-28%)	-834 (-25%)
Shading indicates entrainment increased 10% or more.		
<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.		

5

6 **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be decreased  
7 under Alternative 3 (A3\_LL1) relative to Existing Conditions by 28% (939 fish). Impacts of water  
8 operations on entrainment of river lamprey are considered less than significant, and no mitigation  
9 would be required.

10 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
11 **River Lamprey**

12 In general, effects of Alternative 3 on river lamprey spawning conditions would be negligible  
13 relative to the NAA based.

14 Flow-related impacts on river lamprey spawning habitat were evaluated by estimating effects of  
15 flow alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-  
16 frames for river lamprey incorporated into the analysis. Rapid reductions in flow can dewater redds  
17 leading to mortality. The same locations were analyzed as for Pacific lamprey: the Sacramento River  
18 at Keswick and Red Bluff, Trinity River downstream of Lewiston, Feather River at Thermalito  
19 Afterbay, and American River at Nimbus Dam and at the confluence with the Sacramento River.  
20 River lamprey spawn in these rivers between February and June so flow reductions during those  
21 months have the potential to dewater redds, which could result in incomplete development of the  
22 eggs to ammocoetes (the larval stage).

23 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-  
24 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning  
25 location suitability characteristics (e.g., depth, velocity, and substrate) of river lamprey are not  
26 adequately described to employ a more formal analysis such as a weighted usable area analysis.  
27 Therefore, as described for Pacific lamprey, there is uncertainty that these values represent actual  
28 redd dewatering events, and results should be treated as rough estimates of flow fluctuations under  
29 each model scenario. Results were expressed as the number of cohorts exposed to dewatering risk  
30 and as a percentage of the total number of cohorts anticipated in the river based on the applicable  
31 time-frame, February to June.

32 Results for the Sacramento River indicate that there would be no biologically meaningful effects in  
33 any location evaluated (Table 11-3-56). In the Feather River, the effect is of small magnitude (9%)  
34 and would not have biologically meaningful effects on dewatering risk.

1 **Table 11-3-56. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**  
2 **Cohorts<sup>a</sup>**

Location	Comparison <sup>b</sup>	EXISTING CONDITIONS	
		vs. A3_LLTT	NAA vs. A3_LLTT
Sacramento River at Keswick	Difference	4	1
	Percent Difference	13%	3%
Sacramento River at Red Bluff	Difference	2	0
	Percent Difference	5 %	0%
Trinity River downstream of Lewiston	Difference	-4	-2
	Percent Difference	-6%	-3%
Feather River Below Thermalito Afterbay	Difference	-5	5
	Percent Difference	-7%	9%
American River at Nimbus	Difference	10	1
	Percent Difference	18%	2%
American River at Sacramento River confluence	Difference	16	-1
	Percent Difference	27%	-1%

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

<sup>b</sup> Positive values indicate a higher value in Alternative 3 than under the baseline (EXISTING CONDITIONS or NAA).

3  
4 Because water temperatures under Alternative 3 would be similar to those under Alternative 1A,  
5 results of the analysis on river lamprey egg exposure to elevated temperatures for Alternative 3  
6 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate  
7 that egg exposure would be similar to NAA at most locations, although egg exposure would  
8 moderately increase in the Feather River below Thermalito Afterbay. Because this is isolated to a  
9 single location in the Feather River, it is not expected to cause a population level effect on river  
10 lamprey.

11 **NEPA Effects:** These results indicate that the effect is not adverse because it would not substantially  
12 reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg  
13 mortality. Effects of Alternative 3 on flow would have negligible effects (<5%) in all locations on  
14 redd dewatering risk and exposure to elevated temperatures, with the exception of a single increase  
15 in elevated water temperature exposure in one location, that would not have biologically meaningful  
16 effects on spawning success.

17 **CEQA Conclusion:** In general, effects of Alternative 3 on river lamprey spawning conditions would  
18 be negligible relative to the Existing Conditions.

19 Rapid reductions in flow can dewater redds leading to mortality. Flow-related impacts on river  
20 lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd  
21 dewatering risk as described for Pacific lamprey with appropriate time-frames for river lamprey  
22 incorporated into the analysis, and evaluation of effects of Alternative 3 on water temperatures.

23 Conclusions for Alternative 1A are that effects of Alternative 3 on flow reductions during the river  
24 lamprey spawning period from February to June in the Sacramento River and American River  
25 consist of negligible effects (<5%) in the Sacramento River at Red Bluff, Trinity River, and Feather

1 River (Table 11-3-56). There would be increases in river lamprey redd cohort dewatering risk  
2 relative to Existing Conditions for the Sacramento River at Keswick (13%), and for the American  
3 River at Nimbus Dam (15%) and at the confluence (27%).

4 Because water temperatures under Alternative 3 would be similar to those under Alternative 1A,  
5 results of the analysis on egg exposure to elevated temperatures for Alternative 3 would be similar  
6 to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure  
7 would be greater than under Existing Conditions at the Sacramento, Feather, American, and  
8 Stanislaus Rivers.

### 9 **Summary of CEQA Conclusion**

10 Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between  
11 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
12 alternative could substantially, reduce suitable spawning habitat and substantially reduce the  
13 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. River  
14 lamprey egg exposure to elevated water temperatures would be greater than under Existing  
15 Conditions at the Sacramento, Feather, American, and Stanislaus Rivers. However, there would be  
16 negligible effects (<5%) on redd dewatering in the Sacramento River at Red Bluff, the Trinity River,  
17 and the Feather River; the increased exposure of river lamprey redd cohorts to dewatering from the  
18 project predicted for the Sacramento River at Keswick and the American River consist of small  
19 (13%, 15%) to moderate (27%) increased risks of dewatering that would not have biologically  
20 meaningful negative effects.

21 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
22 change, future water demands, and implementation of the alternative. The analysis described above  
23 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
24 alternative from those of sea level rise, climate change and future water demands using the model  
25 simulation results presented in this chapter. However, the increment of change attributable to the  
26 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
27 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
28 implementation period, which does include future sea level rise, climate change, and water  
29 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
30 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
31 effect of the alternative from those of sea level rise, climate change, and water demands.

32 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
33 term implementation period and Alternative 3 indicates that flows in the locations and during the  
34 months analyzed above would generally be similar between Existing Conditions during the LLT and  
35 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
36 found above would generally be due to climate change, sea level rise, and future demand, and not  
37 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
38 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
39 result in a significant impact on spawning and egg incubation habitat for river lamprey. This impact  
40 is found to be less than significant and no mitigation is required.

### 41 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

42 In general, effects of Alternative 3 on river lamprey rearing conditions would be negligible relative  
43 to the NAA,

1 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can  
 2 strand ammocoetes leading to mortality. Flow-related effects on river lamprey rearing habitat were  
 3 evaluated by estimating effects of flow alterations on ammocoete exposure, or stranding risk, as  
 4 described for Pacific lamprey. Effects of Alternative 3 on flow were evaluated in the Sacramento  
 5 River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus  
 6 Dam and at the confluence with the Sacramento River. As for Pacific lamprey, the analysis of river  
 7 lamprey ammocoete stranding was conducted by analyzing a range of month-over-month flow  
 8 reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of  
 9 ammocoetes was assumed to be born every month during their spawning period (February through  
 10 June) and spend 5 years rearing upstream. Therefore, a cohort was considered stranded if at least  
 11 one month-over-month flow reduction was greater than the flow reduction at any time during the  
 12 period.

13 For evaluation of ammocoete stranding risk, comparisons of Alternative 3 to NAA for the  
 14 Sacramento River at Keswick (Table 11-3-57) indicated either no effect (0%), negligible effects  
 15 (<5% difference), or a small increase (11%) or decrease (-7%) in cohort exposure due to flow  
 16 reductions attributable to the project. These results indicate that the project-related effects of  
 17 Alternative 3 on flow reductions consist of negligible or small effects on ammocoete exposure to  
 18 flow reductions and would not cause biologically meaningful effects in the Sacramento River at  
 19 Keswick.

20 **Table 11-3-57. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 21 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**  
 22 **Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LL1	NAA vs. A3_LL1
-50%	0	0
-55%	2	0
-60%	6	3
-65%	12	11
-70%	0	0
-75%	-2	4
-80%	4	-7
-85%	44	0
-90%	NA	NA

Note: Negative values indicate reduced cohort exposure, a benefit of Alternative 3.  
 NA = could not be calculated because the denominator was 0.

23  
 24 Results of comparisons for the Sacramento River at Red Bluff (Table 11-3-58) indicate no change  
 25 (0%) or negligible effects (<5%) attributable to the project with the exception of a small increase  
 26 (5%) in exposure to 60% flow reductions, which would not have biologically meaningful negative  
 27 effects, and a decrease (-14%) in exposure to 75% flow reductions, which would have a small  
 28 beneficial effect. These results indicate that the effects of Alternative 3 on flow reductions would not  
 29 have biologically meaningful effects on river lamprey ammocoete stranding in the Sacramento River  
 30 at Red Bluff, relative to NAA.

1 **Table 11-3-58. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 3 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	5	1
-60%	12	5
-65%	-3	-4
-70%	10	1
-75%	5	-14
-80%	6	-4
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

4  
 5 Comparisons for the Trinity River negligible effects (<5%) or reductions in exposures (-5%) in all  
 6 flow categories attributable to the project, under Alternative 3 relative to NAA (Table 11-3-59).  
 7 These results indicate that project-related effects of Alternative 3 on flow would not have  
 8 biologically meaningful effects on river lamprey ammocoete stranding in the Trinity River.

9 **Table 11-3-59. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	29	-2
-80%	32	-5
-85%	24	-5
-90%	47	-4

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

11  
 12 Comparisons for the Feather River (A3\_LLT compared to NAA) indicate negligible effects (<5%) or  
 13 reductions in exposures (to -32%) in all flow categories attributable to the project, which would  
 14 have beneficial effects on ammocoete rearing success (Table 11-3-60). These results indicate that  
 15 project-related effects of Alternative 3 on flow would not have biologically meaningful negative  
 16 effects on river lamprey ammocoete stranding in the Feather River, relative to NAA.

1 **Table 11-3-60. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
 3 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-8	-2
-85%	5	-20
-90%	-62	-32

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

4  
 5 Comparisons for the American River at Nimbus Dam(A3\_LLT compared to NAA) (Table 11-3-61)  
 6 and at the confluence with the Sacramento River (Table 11-3-62) indicate no effect (0%), negligible  
 7 effects (<5%), or small increases or decreases (to 12%) that would not have biologically meaningful  
 8 effects on spawning success. These results indicate that project-related effects of Alternative 3 on  
 9 flow would not have biologically meaningful negative effects on river lamprey ammocoete stranding  
 10 in the American River, relative to NAA.

11 **Table 11-3-61. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
 13 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	7	-1
-70%	41	-11
-75%	117	-4
-80%	354	-4
-85%	420	-7
-90%	236	12

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

14

1 **Table 11-3-62. Relative Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. A3_LLT	NAA vs. A3_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	4	-1
-70%	15	-7
-75%	62	5
-80%	241	0
-85%	330	0
-90%	396	7

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of Alternative 3.

4

5 Because water temperatures under Alternative 3 would be similar to those under Alternative 1A,  
 6 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 3 would be  
 7 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there  
 8 would be small to moderate increases and decreases in exposure relative to NAA that will balance  
 9 out within rivers such that there would be no overall effect on river lamprey ammocoetes.

10 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
 11 substantially reduce rearing habitat or substantially reduce the number of fish as a result of  
 12 ammocoete mortality. Effects of Alternative 3 on ammocoete rearing in all locations analyzed would  
 13 consist of negligible effects on flow reductions (<5% difference), small increases in occurrence of  
 14 one or more flow reduction categories (to 12%) that would not have biologically meaningful effects,  
 15 and small to substantial reductions (7% to 32% lower) in occurrence of flow reductions that would  
 16 have beneficial effects on rearing success. Decreased occurrence of flow reduction events (i.e., a  
 17 beneficial effect) would be most consistent and of the greatest magnitude in the Feather River, with  
 18 reductions up to 32% for all flow reduction categories. In addition, there would be small to  
 19 moderate increases and decreases in ammocoete exposure to elevated water temperatures that will  
 20 balance out within rivers such that there would be no overall effect on river lamprey ammocoetes.

21 **CEQA Conclusion:** In general, under Alternative 3 water operations, the quantity and quality of  
 22 spawning and egg incubation habitat for river lamprey rearing habitat would not be affected relative  
 23 to the CEQA baseline.

24 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can  
 25 strand ammocoetes leading to mortality. Flow-related effects on river lamprey rearing habitat were  
 26 evaluated by estimating effects of flow alterations on ammocoete exposure, or stranding risk, as  
 27 described for Pacific lamprey, and effects of Alternative 3 on water temperature.

28 For evaluation of ammocoete stranding risk, comparisons of Alternative 3 to Existing Conditions for  
 29 the Sacramento River at Keswick indicate negligible effects (<5%) on the number of ammocoete  
 30 cohorts exposed to flow reductions for all flow reduction categories (Table 11-3-57) with the  
 31 exception of a small increase (12%) in month-over-month flow reductions of 65% and a 44%

1 increase in reductions of 85%. Comparisons for the Sacramento River at Red Bluff indicate slightly  
2 more variable results with negligible effects (<5%) for all flow reduction categories except for small  
3 increases (5% to 12%) in the 55%, 60%, and 70% flow reduction categories, and a more substantial  
4 increase (100%, or from 25 to 50 cohorts) in the 85% flow reduction category (Table 11-3-58).  
5 While there would be a fairly substantial increase in the number of cohorts exposed to the 85%  
6 reduction category, effects would be negligible or small in all other flow reduction categories and  
7 therefore conclusions are that effects of Alternative 3 on flow reductions would not have biologically  
8 meaningful effects on river lamprey ammocoete stranding in the Sacramento River.

9 Comparisons for the Trinity River indicated no effect (0%) for flow reduction categories from 50%  
10 to 70%, and increases ranging from 24% to 47% for the higher flow reduction categories (Table 11-  
11 3-59). These consistent and more substantial increases in ammocoete cohort exposures to larger  
12 flow reductions would have negative effects on ammocoete rearing success through meaningful  
13 increases in risk of stranding.

14 Comparisons for the Feather River indicated no effect or reductions in frequency of occurrence for  
15 all flow reduction categories with the exception of a small increase in cohort exposure (5%) to 85%  
16 flow reductions (Table 11-3-60). These results indicate that the effects of Alternative 3 on flow  
17 would not have biologically meaningful effects on river lamprey ammocoete stranding in the  
18 Feather River.

19 Comparisons for the American River at Nimbus Dam (Table 11-3-61) and at the confluence with the  
20 Sacramento River (Table 11-3-62) indicate increased ammocoete cohort exposures to flow  
21 reductions between 70 and 90% for Alternative 3 compared to Existing Conditions; meaningful  
22 (>5%) predicted increases are from 117 to 420% (increase in cohorts exposed from 25 to 130) for  
23 Nimbus Dam and from 15 to 396% (increase in cohorts exposed from 25 to 124) for the confluence.  
24 These consistent and substantial increases in ammocoete cohorts exposed to flow reductions would  
25 have negative effects on ammocoete rearing success through increased risk of stranding in the  
26 American River.

27 Because water temperatures under Alternative 3 would be similar to those under Alternative 1A,  
28 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 3 would be  
29 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there  
30 would be moderate to large increases in ammocoete exposure under Alternative 1A relative to  
31 Existing Conditions in all rivers evaluated that would substantially reduce rearing habitat  
32 conditions.

### 33 **Summary of CEQA Conclusion**

34 Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between  
35 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
36 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
37 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Alternative 3  
38 would have substantial effects on ammocoete cohort stranding in the Trinity River (increases to  
39 47% for the larger flow reduction categories) and American River (increases to 420% for the larger  
40 flow reduction categories), but would not have effects in the Sacramento River and the Feather  
41 River (based on negligible effects, <5%, small increases, to 12%, in some flow reduction categories,  
42 or larger, isolated increases, to 100%, in a single flow reduction category). In addition, there would  
43 be moderate to large increases in ammocoete exposure in all rivers evaluated that would  
44 substantially reduce rearing habitat conditions for river lamprey.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and Alternative 3 indicates that flows in the locations and during the  
14 months analyzed above would generally be similar between Existing Conditions during the LLT and  
15 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
16 found above would generally be due to climate change, sea level rise, and future demand, and not  
17 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
19 result in a significant impact on rearing habitat for river lamprey. This impact is found to be less  
20 than significant and no mitigation is required.

#### 21 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

22 In general, effects of Alternative 3 on river lamprey migration conditions would be negligible  
23 relative to the NAA.

#### 24 ***Macrophthalmia***

25 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once  
26 they reach the Delta. River lamprey migration generally occurs September through November (U.S.  
27 Fish and Wildlife Service unpublished data). The effects of water operations on seasonal migration  
28 flows for river lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along  
29 the likely migration pathways of river lamprey during the likely migration period (September  
30 through November) were examined to predict how Alternative 3 may affect migration flows for  
31 outmigrating macrophthalmia.

32 Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with  
33 the Sacramento River, and the American River at the confluence with the Sacramento River.

#### 34 ***Sacramento River***

35 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*  
36 *in the Fish Analysis*) for September through November (A3\_LLТ compared to NAA) indicates  
37 negligible effects (<5%) or project-related decreases (to -43%) in wetter water years during  
38 September and a moderate increase (17%) in critical years, more substantial increases to 33%  
39 during October in all water years, and decreases to -29% during November in all water years. The  
40 more substantial decreases in flow during September would occur in wetter water years when  
41 effects on migration would be less critical. Increases in mean monthly flow during October would  
42 have a beneficial effect on migration, and decreases during drier years (when effects would be more

1 critical for migration) during November are relatively small (-23% in below normal years, -13% in  
2 dry years, and -8% in critical years). These results indicate that while flow reductions would occur,  
3 flow reductions would not be consistent or substantial enough throughout the migration period to  
4 have biologically meaningful effects on outmigrating macrophthalmia.

#### 5 *Feather River*

6 Comparisons for the Feather River at the confluence with the Sacramento River for September  
7 through November indicate decreases in mean monthly flows (to -68%) during September in all but  
8 critical years (increase of 9%), primarily increased flows during October (to 23%), and small  
9 decreases during November in wetter water years (to -11%) and a small increase (6%) or negligible  
10 effect (<5%) in drier years. Isolating the effects of the project from the effects of climate change  
11 (A3\_LLT compared to NAA) indicates project-related effects would cause decreases in mean  
12 monthly flow during September in wetter years (to -53%) when effects on migration would be less  
13 critical, and increases (to 19%) in drier years which would have a beneficial effect on migration;  
14 primarily increases during October (to 56%) which would have beneficial effects on migration  
15 conditions, and negligible effects (<5%) or small increases or decreases during November (to 13%)  
16 which would not have biologically meaningful effects on migration conditions. These results indicate  
17 that effects of Alternative 3 on flow would not have biologically meaningful effects on river lamprey  
18 macrophthalmia migration in the Feather River.

#### 19 *American River*

20 Comparisons for the American River at the confluence with the Sacramento River for September  
21 through November indicate substantial reductions in flows during September in all water years  
22 (-31 to -58%), and during November in all water years (-13% to -39%). Flow during October would  
23 increase in all water years (18% to 40%). Isolating the effects of the project from the effects of  
24 climate change (A3\_LLT compared to NAA) indicates a slightly smaller project-related contribution  
25 to decreased flows during September in wetter water years (to -50%) and a negligible effect (<5%)  
26 and small increase (6%) in drier water years when flow effects would be more critical for migration,  
27 increases in mean monthly flows during October in all water years (to 33%) which would have  
28 beneficial effects on migration, and negligible project-related changes during November except for  
29 relatively small decrease in mean monthly flow (-15%) in above normal water years. These results  
30 indicate that project-related effects of Alternative 3 on flows would not have biologically meaningful  
31 effects on river lamprey macrophthalmia migration in the American River.

32 Overall, despite some variation in results by location, month, and water year type, these results  
33 indicate that Alternative 3 would not have biologically meaningful effects on river lamprey  
34 macrophthalmia migration.

#### 35 **Adults**

36 Effects of Alternative 3 on flow during the adult migration period, September through November,  
37 would be the same as described for the macrophthalmia migration period, September through  
38 November, above.

39 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
40 substantially reduce the amount of suitable habitat or substantially interfere with the movement of  
41 fish. Effects of Alternative 3 on flow would generally consist of negligible effects (<5% difference),  
42 increases in mean monthly flow, to 56%, that would have beneficial effects on migration conditions,

1 small to moderate decreases, to -29%, in drier years that would not occur with sufficient frequency  
2 to have biologically meaningful effects, and more substantial decreases in flow, to -53%, that would  
3 occur in wetter years when flow reductions would not have negative effects on migration conditions  
4 due to higher flow conditions.

5 **CEQA Conclusion:** In general, under Alternative 3 water operations, the quantity and quality of river  
6 lamprey migration habitat would not be affected relative to the CEQA baseline.

### 7 ***Macrophthalmia***

#### 8 *Sacramento River*

9 Comparisons for the Sacramento River at Red Bluff for September through November indicate  
10 variable effects of Alternative 3 during September, with negligible effects (<5%) or a small increase  
11 in flow (9%, above normal years), with the exception of moderate flow reductions in wet years  
12 (-24%) and dry years (-20%). Effects during October would consist of increases in mean monthly  
13 flow for all water year types (14 to 30%) that would have a beneficial effect on migration conditions.  
14 Effects during November would consist of relatively small to moderate reductions in mean monthly  
15 flow (-5% to -21%) in all water years, with the maximum flow reduction in a drier water year type  
16 of -15% (dry years). Flow reductions during September (-20%) and November (-15%) in dry years,  
17 and smaller reductions during November in below normal (-13%) and critical years (-10%), would  
18 have incremental effects on migration conditions. However, these effects would be offset by more  
19 substantial increases in October. Overall effects of Alternative 3 on flows would not have biologically  
20 meaningful effects on river lamprey macrophthalmia migration conditions in the Sacramento River.

#### 21 *Feather River*

22 Comparisons for the Feather River at the confluence with the Sacramento River for September  
23 through November indicate variable results by month and water year type, with primarily decreases  
24 (to -24%) during September with the exception of an increase (14%) in critical years, primarily  
25 increases in mean monthly flow during October (to 40%), and negligible effects (<5%) or small-  
26 scale increases (6%) or decreases (to -13%) in flow that would not be of a magnitude to cause  
27 biologically meaningful effects. While decreases for some of the drier water years during September  
28 and below normal years during November would contribute incrementally to migration conditions,  
29 overall effects of Alternative 3 on flows would not have biologically meaningful negative effects on  
30 river lamprey macrophthalmia migration conditions in the Feather River.

#### 31 *American River*

32 Comparisons for the American River at the confluence with the Sacramento River for September  
33 through November indicate reductions in flow during September and November in all water year  
34 types, ranging from -15 to -55%, and increases in mean monthly flow during October for all water  
35 years ranging from 9% to 30%. The increases in mean monthly flow during October would have a  
36 beneficial effect on migration conditions, but the predominance of moderate to substantial  
37 decreased flows under Alternative 3 during September and November in all water years (with  
38 decreases during drier water years ranging from -15% to -55%) would have negative effects on  
39 river lamprey macrophthalmia migration conditions in the American River.

40 Overall, these results indicate that effects of Alternative 3 on flow from September through  
41 November would not have biologically meaningful effects on river lamprey macrophthalmia

1 migration in the Sacramento River and the Feather River, but would have negative effects in the  
2 American River.

### 3 **Adults**

4 Effects of Alternative 3 on flow during the adult migration period, September through November,  
5 would be the same as described for the macrophthalmia migration period, September through  
6 November, above.

### 7 **Summary of CEQA Conclusion**

8 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between  
9 the CEQA baseline and Alternative 3 could be significant because, under the CEQA baseline, the  
10 alternative could substantially reduce the amount of suitable habitat and substantially interfere with  
11 the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 3 on  
12 flow would be substantial for river lamprey macrophthalmia and adult migration conditions in the  
13 American River based on substantial flow reductions for all water year types, including in drier  
14 years (to -55%), during two out of three months of the migration period. There would be no  
15 negative effects of Alternative 3 on flow in the Sacramento River or Feather River based on  
16 negligible effects (<5% difference), increases in mean monthly flow (to 40%) that would have  
17 beneficial effects on migration, moderate decreases (to -24%) in wetter years when effects on  
18 migration would not be as critical, and infrequent, small to moderate decreases in drier years (to -  
19 20%) that would not have biologically meaningful effects.

20 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
21 change, future water demands, and implementation of the alternative. The analysis described above  
22 comparing Existing Conditions to Alternative 3 does not partition the effect of implementation of the  
23 alternative from those of sea level rise, climate change and future water demands using the model  
24 simulation results presented in this chapter. However, the increment of change attributable to the  
25 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
26 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
27 implementation period, which does include future sea level rise, climate change, and water  
28 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
29 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
30 effect of the alternative from those of sea level rise, climate change, and water demands.

31 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
32 term implementation period and Alternative 3 indicates that flows in the locations and during the  
33 months analyzed above would generally be similar between Existing Conditions during the LLT and  
34 Alternative 3. This indicates that the differences between Existing Conditions and Alternative 3  
35 found above would generally be due to climate change, sea level rise, and future demand, and not  
36 the alternative. As a result, the CEQA conclusion regarding Alternative 3, if adjusted to exclude sea  
37 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself  
38 result in a significant impact on migration conditions for river lamprey. This impact is found to be  
39 less than significant and no mitigation is required.

### 40 **Restoration Measures (CM2, CM4–CM7, and CM10)**

41 Alternative 3 has the same restoration measures as Alternative 1A. Because no substantial  
42 differences in restoration-related fish effects are anticipated anywhere in the affected environment

1 under Alternative 3 compared to those described in detail for Alternative 1A, the fish effects of  
2 restoration measures described for river lamprey under Alternative 1A (Impact AQUA-187 through  
3 AQUA-189) also appropriately characterize effects under Alternative 3.

4 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

5 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

6 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**  
7 **Lamprey**

8 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

9 *NEPA Effects:* All three of these effects have been determined to result in no adverse effects on river  
10 lamprey for the reasons identified for Alternative 1A.

11 *CEQA Conclusion:* All three of these impacts would be considered less than significant for the  
12 reasons identified for Alternative 1A.

13 **Other Conservation Measures (CM12–CM19 and CM21)**

14 Alternative 3 has the same other conservation measures as Alternative 1A. Because no substantial  
15 differences in other conservation-related fish effects are anticipated anywhere in the affected  
16 environment under Alternative 3 compared to those described in detail for Alternative 1A, the fish  
17 effects of other conservation measures described for river lamprey under Alternative 1A (Impact  
18 AQUA-190 through AQUA-198) also appropriately characterize effects under Alternative 3.

19 The following impacts are those presented under Alternative 1A that are identical for Alternative 3.

20 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

21 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
22 **(CM13)**

23 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

24 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

25 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

26 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

27 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

28 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

29 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
30 **(CM21)**

1 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no  
2 adverse effect, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified  
3 for Alternative 1A.

4 **CEQA Conclusions:** The nine impact mechanisms would be considered to range from no impact, to  
5 less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A, and  
6 no mitigation is required.

## 7 **Non-Covered Aquatic Species of Primary Management Concern**

### 8 **Construction and Maintenance of CM1**

9 The effects of construction and maintenance of CM1 under Alternative 3 would be similar for all  
10 non-covered species; therefore, the analysis below is combined for all non-covered species instead  
11 of analyzed by individual species.

### 12 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered** 13 **Aquatic Species of Primary Management Concern**

14 Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water  
15 conveyance facilities on non-covered species of primary management concern. The potential effects  
16 of the construction of water conveyance facilities under Alternative 3 would be similar to those  
17 described for Alternative 1A (see Alternative 1A, Impact AQUA-1) except that Alternative 3 would  
18 include two intakes compared to five intakes under Alternative 1A, so the effects would be  
19 proportionally less under this alternative. This would convert about 4,450 lineal feet of existing  
20 shoreline habitat into intake facility structures and would require about 10.2 acres of dredge and  
21 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
22 would require 27.3 acres of dredging. The effects related to temporary increases in turbidity,  
23 accidental spills, underwater noise, in-water work activities, and disturbance of contaminated  
24 sediments would be similar to Alternative 1A and the same environmental commitments and  
25 mitigation measures (described under Impact AQUA-1 for delta smelt and in Appendix 3B,  
26 *Environmental Commitments*) would be available to avoid and minimize potential effects.  
27 Additionally, California bay shrimp would not be affected because they do not occur in the vicinity  
28 and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary  
29 distributions are upstream.

30 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and  
31 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
32 not be adverse for non-covered aquatic species of primary management concern.

33 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-1, the impact of the construction of  
34 the water conveyance facilities on non-covered aquatic species of primary management concern  
35 would not be significant except for construction noise associated with pile driving. Potential pile  
36 driving impacts would be less than Alternative 1A because only two intakes would be constructed  
37 rather than five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b  
38 would reduce that noise impact to less than significant.

1       **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2       **of Pile Driving and Other Construction-Related Underwater Noise**

3       Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4       **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
5       **and Other Construction-Related Underwater Noise**

6       Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7       **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
8       **Aquatic Species of Primary Management Concern**

9       Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water  
10       conveyance facilities on non-covered species of primary management concern. That discussion  
11       under delta smelt addresses the type, magnitude, and range of impact mechanisms that are relevant  
12       to the aquatic environment and aquatic species.

13       **NEPA Effects:** The potential effects of the construction of water conveyance facilities under  
14       Alternative 3 would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
15       AQUA-200). For a detailed discussion, please see Alternative 1A, Impact AQUA-200. California bay  
16       shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin  
17       roach and hardhead are unlikely to be affected because their primary distributions are upstream.  
18       Consequently, the effects would not be adverse.

19       **CEQA Conclusion:** As described above, these impacts would be less than significant.

20       **Water Operations of CM1**

21       The effects of water operations of CM1 under Alternative 3 include a detailed analysis of the  
22       following species:

- 23       ● Striped Bass
- 24       ● American Shad
- 25       ● Threadfin Shad
- 26       ● Largemouth Bass
- 27       ● Sacramento tule perch
- 28       ● Sacramento-San Joaquin roach—California species of special concern
- 29       ● Hardhead—California species of special concern
- 30       ● California bay shrimp

31       **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
32       **Species of Primary Management Concern**

33       Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-  
34       covered species of primary management concern.

1       **Striped Bass**

2       Striped bass eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP  
3       Delta diversions and the alternate NBA intake as these life stages are passively transported  
4       downstream to the north Delta. State of the art fish screens on these north Delta intakes though  
5       would exclude juvenile and adult striped bass.

6       Entrainment losses under Alternative 3 to the SWP/CVP south Delta intakes would be expected to  
7       decrease compared to NAA since exports from the south Delta facilities would be substantially  
8       reduced in the summer. This result is based on the assumption that striped bass entrainment is  
9       proportional to south Delta exports.

10       Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile  
11       striped bass (Nobriga et al. 2004). Reduction or consolidation of diversions from the ROAs  
12       (approximately 4–12% of diversions) would not increase entrainment and may provide a minor  
13       benefit. Also, restoration activities as part of the conservation measures should increase the amount  
14       of habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The  
15       expectation is that these habitat changes would result in at least a minor improvement in production  
16       of juvenile striped bass.

17       **NEPA Effects:** Variations in striped bass survival rates during the first few months of life are  
18       moderated by a population bottleneck between YOY striped bass and three-year-old individuals  
19       (Kimmerer et al. 2000). Therefore it would be expected that reductions in entrainment of juveniles  
20       and adults at the south Delta intakes would have a greater population impact than increases in  
21       entrainment of striped bass larvae and eggs at the proposed SWP/CVP north Delta intakes and the  
22       NBA intake. Furthermore, decommissioning of agricultural diversions may also reduce entrainment  
23       of striped bass. Overall, the effect on striped bass entrainment would not be adverse.

24       **CEQA Conclusion:** The impact of water operations on entrainment of striped bass would be the  
25       same as described immediately above. The changes in entrainment under Alternative 3 would not  
26       substantially reduce the striped bass population when other conservation measures are taken into  
27       account. The impact would be less than significant and no mitigation would be required.

28       **American Shad**

29       American shad eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP  
30       Delta diversions and the alternate NBA intake as these life stages are passively transported  
31       downstream to the north Delta. State of the art fish screens on these north Delta intakes though  
32       would exclude juvenile and adult American shad.

33       **NEPA Effects:** American shad entrainment losses under Alternative 3 would decrease compared to  
34       NAA due to reduced south Delta exports in the summer. Reduced south Delta entrainment would  
35       also be expected to reduce predation loss associated with these facilities, especially within Clifton  
36       Court Forebay. Reduction or consolidation of agricultural diversions in ROAs would not increase  
37       entrainment. Overall, the effect on American shad would not be adverse, and would be slightly  
38       beneficial.

39       **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the  
40       same as described immediately above. The changes in entrainment under Alternative 3 would not  
41       substantially reduce the American shad population. The impact would be less than significant and  
42       no mitigation would be required.

1       **Threadfin Shad**

2       The effect of water operations on entrainment of threadfin shad would be the same as discussed for  
3       Alternative 1A, Impact AQUA-201. Entrainment at the south Delta would be reduced due to overall  
4       lower exports from south Delta facilities; there would also be a concomitant reduction in predation  
5       loss especially within Clifton Court Forebay. There would be entrainment of threadfin shad eggs and  
6       larvae at the north Delta intakes. Decommissioning agricultural diversions in Delta ROAs would  
7       decrease or have no impact on threadfin shad entrainment.

8       **NEPA Effects:** Overall, threadfin shad entrainment would be reduced because they are most  
9       abundant in the southwestern portion of the Delta and would benefit from reduced south Delta  
10      exports. The effect would not be adverse.

11      **CEQA Conclusion:** The impact of water operations on entrainment of threadfin shad would be the  
12      same as described immediately above. The changes in entrainment under Alternative 3 would not  
13      substantially reduce the threadfin shad population. The impact would be less than significant and no  
14      mitigation would be required.

15      **Largemouth Bass**

16      **NEPA Effects:** Since largemouth bass are predominantly found in the south and central portions of  
17      the Delta, largemouth bass would be most vulnerable to entrainment at south Delta facilities.  
18      Entrainment to the south Delta would be reduced because of reductions in south Delta exports in the  
19      summer. As discussed for Alternative 1A, Impact AQUA-201, few larval largemouth bass would be  
20      vulnerable to entrainment to north Delta and alternative NBA intakes since they are not expected to  
21      readily occur there. Decommissioning agricultural diversions could reduce entrainment of  
22      largemouth bass since they hold in shallow water habitats where most agricultural diversions are  
23      sited. Overall entrainment would be reduced under Alternative 3 and there could be a small benefit  
24      to the species.

25      **CEQA Conclusion:** The impact of water operation on largemouth bass would be as described  
26      immediately above. The changes in entrainment under Alternative 3 could benefit the largemouth  
27      bass population. The impact would be less than significant and no mitigation would be required.

28      **Sacramento Tule Perch**

29      **NEPA Effects:** The effects and conclusion for this impact would be similar to Alternative 1A, Impact  
30      AQUA-201. Entrainment of Sacramento tule perch to the SWP/CVP south Delta facilities would  
31      decrease because south Delta exports would be less compared to NAA (NAA). Entrainment-related  
32      predation loss would also be reduced. Because Sacramento tule perch are viviparous, newly born  
33      Sacramento tule perch would be large enough to be effectively screened at the proposed north Delta  
34      facilities. Reduction or consolidation of the agricultural diversions would decrease entrainment of  
35      Sacramento tule perch into these agricultural intakes. Overall the reduction in entrainment of  
36      Sacramento tule perch under Alternative 3 would not be adverse, and may provide a benefit for the  
37      species.

38      **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would  
39      be the same as described immediately above. The changes in entrainment under Alternative 3 would  
40      not substantially reduce the Sacramento tule perch population. The impact would be less than  
41      significant and no mitigation would be required.

1 **Sacramento-San Joaquin Roach**

2 **NEPA Effects:** The effect of water operations on entrainment of Sacramento-San Joaquin roach  
3 under Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
4 AQUA-201). As described for Alternative 1A, Impact AQUA-201, the effects would not be adverse.

5 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach  
6 would be the same as described immediately above. The impacts would be less than significant.

7 **Hardhead**

8 **NEPA Effects:** The effect of water operations on entrainment of hardhead under Alternative 3 would  
9 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion  
10 under delta smelt addresses the type, magnitude, and range of impact mechanisms that are relevant  
11 to the aquatic environment and aquatic species. As described for Alternative 1A, Impact AQUA-3 the  
12 effects would not be adverse.

13 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same  
14 as described immediately above. The impacts would be less than significant.

15 **California Bay Shrimp**

16 **NEPA Effects:** The effect of water operations on entrainment of California bay shrimp under  
17 Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
18 AQUA-3). That discussion under delta smelt addresses the type, magnitude, and range of impact  
19 mechanisms that are relevant to the aquatic environment and aquatic species. California bay shrimp  
20 do not occur in the vicinity of the intakes and there would be no effect.

21 **CEQA Conclusion:** The impact of water operations on entrainment of California bay shrimp would  
22 be the same as described immediately above. There would be no impact.

23 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
24 **Non-Covered Aquatic Species of Primary Management Concern**

25 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-  
26 covered species of primary management concern.

27 **Striped Bass**

28 In general, Alternative 3 would slightly improve the quality and quantity of upstream habitat  
29 conditions for striped bass relative to NAA.

30 **Flows**

31 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
32 Clear Creek were examined during the April through June striped bass spawning, embryo  
33 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
34 habitat available for spawning, egg incubation, and rearing.

35 In the Sacramento River upstream of Red Bluff, flows under A3\_LL1T would generally be similar to or  
36 greater than flows under NAA during April through June except in wet years during May compared  
37 to NAA (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
2 greater than flows under NAA during April through June except in above normal years during April  
3 (11% lower)(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to flows under  
5 NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
7 greater by up to 162% than flows under NAA during April through June, regardless of water year  
8 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the American River at Nimbus Dam, flows under A3\_LLT would be similar to or greater than flows  
10 under NAA, regardless of water year type.

11 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
12 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
13 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 14 **Water Temperature**

15 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
16 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
17 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
18 range could lead to reduced spawning success and increased egg and larval stress and mortality.  
19 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

20 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
21 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
22 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
23 temperature related effects in these rivers during the April through June period. Further, water  
24 temperatures were not modeled in Clear Creek or the San Joaquin River.

25 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
26 Alternative 3 would not cause a substantial reduction in striped bass spawning, incubation, or initial  
27 rearing habitat. Flows in all rivers examined during the April through June spawning, incubation,  
28 and initial rearing period under Alternative 3 would generally be similar to flows under NAA. In the  
29 Feather River, flows under Alternative 3 would be greater than flows under NAA, indicating that the  
30 alternative would provide flow-related improvements to upstream habitat for striped bass. There  
31 would be no temperature-related effects of Alternative 3 on upstream striped bass habitat.

32 **CEQA Conclusion:** In general, Alternative 3 would slightly improve the quality and quantity of  
33 upstream habitat conditions for striped bass relative to the Existing Conditions.

#### 34 **Flows**

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
36 Clear Creek were examined during the April through June striped bass spawning, embryo  
37 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
38 habitat available for spawning, egg incubation, and rearing.

39 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
40 flows under Existing Conditions during April and generally greater than flows under Existing

1 Conditions during May and June, except in wet years during May (14% lower) (Appendix 11C,  
2 *CALSIM II Model Results utilized in the Fish Analysis*).

3 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
4 greater than flows under Existing Conditions during April through June, except in critical years  
5 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to flows under  
7 Existing Conditions during April through June, except in critical water years, in which flows would  
8 be 6% to 14% greater under A3\_LLT depending on month (Appendix 11C, *CALSIM II Model Results*  
9 *utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
11 greater by up to 149% than flows under Existing Conditions during April through June, except in  
12 wet years during May (30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
13 *Analysis*).

14 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to or greater  
15 than flows under Existing Conditions during April and June, except in above normal years during  
16 April (6% lower) and wet and critical years during June (26% and 39% lower, respectively)  
17 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May would  
18 generally up to 25% than under Existing Conditions.

19 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
20 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
21 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
22 during the period relative to Existing Conditions.

### 23 **Water Temperature**

24 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
25 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
26 the Sacramento, Trinity, Feather, American. Water temperatures outside this range could lead to  
27 reduced spawning success and increased egg and larval stress and mortality. Water temperatures  
28 were not modeled in the San Joaquin River or Clear Creek.

29 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
30 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
31 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
32 temperature related effects in these rivers during the April through June period.

33 Collectively, these results indicate that the impact would be less than significant because Alternative  
34 3 would result in a cumulative improvement of spawning, incubation, and initial rearing habitat.  
35 Therefore, no mitigation is necessary. Flows in all rivers examined during the April through June  
36 spawning, incubation, and initial rearing habitat of striped bass. Flows in all rivers except the San  
37 Joaquin and Stanislaus rivers during the April through June spawning, incubation, or initial rearing  
38 period under Alternative 3 would generally be similar to or greater than flows under the Existing  
39 Conditions. Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 3  
40 relative to the Existing Conditions, although this effect would not be biologically meaningful to  
41 striped bass. There would be no temperature-related effects of Alternative 3 on upstream striped  
42 bass habitat.

1 **American Shad**

2 In general, Alternative 3 would slightly improve the quality and quantity of upstream habitat  
3 conditions for American shad relative to the NAA.

4 **Flows**

5 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
6 Clear Creek were examined during the April through June American shad adult migration and  
7 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
8 quality for spawning.

9 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to or  
10 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
11 *utilized in the Fish Analysis*).

12 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
13 greater than flows under NAA during April through June except in above normal years during April  
14 (11% lower)(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to flows under  
16 NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
18 greater by up to 162% than flows under NAA during April through June, regardless of water year  
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 In the American River at Nimbus Dam, flows under A3\_LLT would be similar to or greater than flows  
21 under NAA, regardless of water year type.

22 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
23 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
24 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

25 **Water Temperature**

26 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
27 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
28 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
29 reduced spawning success and increased adult migrant stress and mortality. Water temperatures  
30 were not modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, Feather American, and Stanislaus rivers under  
32 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
33 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
34 temperature related effects in these rivers during the April through June period. Further, water  
35 temperatures were not modeled in Clear Creek or the San Joaquin River.

36 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
37 Alternative 3 would not cause a substantial reduction in American shad spawning or adult  
38 migration. Flows in all rivers examined during the April through June adult migration and spawning  
39 period under Alternative 3 would nearly always be similar to flows would generally be similar to  
40 flows under the NAA. In the Feather River, flows under Alternative 3 would be greater than flows

1 under the NAA, indicating that the alternative would provide flow-related improvements to  
2 upstream habitat for American shad. There would be no temperature-related effects of Alternative 3  
3 on upstream American shad habitat.

4 **CEQA Conclusion:** In general, Alternative 3 would slightly improve the quality and quantity of  
5 upstream habitat conditions for American shad relative to the Existing Conditions.

#### 6 **Flows**

7 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
8 Clear Creek were examined during the April through June American shad adult migration and  
9 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
10 quality for spawning.

11 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
12 flows under Existing Conditions during April and generally greater than flows under Existing  
13 Conditions during May and June, except in wet years during May (14% lower) (Appendix 11C,  
14 *CALSIM II Model Results utilized in the Fish Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
16 greater than flows under Existing Conditions during April through June, except in critical years  
17 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to flows under  
19 Existing Conditions during April through June, except in critical water years, in which flows would  
20 be 6% to 14% greater under A3\_LLT depending on month (Appendix 11C, *CALSIM II Model Results  
21 utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
23 greater by up to 149% than flows under Existing Conditions during April through June, except in  
24 wet years during May (30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
25 Analysis*).

26 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to or greater  
27 than flows under Existing Conditions during April and June, except in above normal years during  
28 April (6% lower) and wet and critical years during June (26% and 39% lower, respectively)  
29 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May would  
30 generally up to 25% than under Existing Conditions.

31 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
32 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
33 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
34 during the period relative to Existing Conditions.

#### 35 **Water Temperature**

36 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
37 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
38 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
39 reduced spawning success and increased adult migrant stress and mortality. Water temperatures  
40 were not modeled in the San Joaquin River or Clear Creek.

1 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
2 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
3 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
4 temperature related effects in these rivers during the April through June period.

5 Collectively, these results indicate that the impact would be less than significant because Alternative  
6 3 would not cause a substantial reduction in American shad adult migration and spawning habitat,  
7 and no mitigation would be required. Flows in all rivers examined during the April through June  
8 adult migration and spawning period under Alternative 3 would nearly always be similar to or  
9 greater than flows under the Existing Conditions. Flows in the San Joaquin and Stanislaus rivers  
10 would be lower under Alternative 3 relative to the Existing Conditions, although this effect would  
11 not be biologically meaningful to American shad. There would be no temperature-related effects of  
12 Alternative 3 on upstream American shad habitat.

### 13 **Threadfin Shad**

14 In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
15 threadfin shad relative to NAA.

### 16 **Flows**

17 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
18 Clear Creek were examined during April through August threadfin shad spawning period. Lower  
19 flows could reduce the quantity and quality of instream habitat available for spawning.

20 In the Sacramento River upstream of Red Bluff, flows under A3\_LLTP would generally be similar to  
21 flows under NAA during April, June, and July, greater by up to 15% during May, and lower by up to  
22 18% during August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 In the Trinity River below Lewiston Reservoir, flows under A3\_LLTP would be similar to flows under  
24 NAA, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model  
25 Results utilized in the Fish Analysis*).

26 In Clear Creek at Whiskeytown Dam, flows under A3\_LLTP would nearly always be similar to or  
27 greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results  
28 utilized in the Fish Analysis*).

29 In the Feather River at Thermalito Afterbay, flows under A3\_LLTP would generally be greater during  
30 April through June (up to 72% greater) and lower (by up to 44%) than flows under NAA during July  
31 and August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 In the American River at Nimbus Dam, flows under A3\_LLTP would generally be similar to flows  
33 under NAA during April, greater by up to 31% during May and June, and lower by up to 30% during  
34 July and August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
36 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
37 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

1 *Water Temperature*

2 The percentage of months below 68°F water temperature threshold for the April through August  
3 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
4 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful  
5 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear  
6 Creek.

7 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
8 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
9 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
10 temperature-related effects in these rivers throughout the year.

11 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
12 Alternative 3 would not cause a substantial reduction in spawning habitat. Flows in all rivers  
13 examined during the April through August spawning period under Alternative 3 would generally be  
14 similar to or greater than flows under the NAA, except during summer months in the Sacramento,  
15 Feather, and American rivers. Lower flows during these months these rivers are not of sufficient  
16 magnitude or frequency to have a biologically meaningful effect on threadfin shad. The percentage  
17 of months below the spawning temperature threshold would be similar in all rivers between  
18 Alternative 3 and the NAA.

19 **CEQA Conclusion:** In general, Alternative 3 would not affect the quality and quantity of upstream  
20 habitat conditions for threadfin shad relative to the Existing Conditions.

21 **Flows**

22 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
23 Clear Creek were examined during April through August spawning period. Lower flows could reduce  
24 the quantity and quality of instream habitat available for spawning.

25 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
26 flows under Existing Conditions during April and July, greater by up to 20% during May and June,  
27 and lower by up to 24% during August (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
28 *Analysis*).

29 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to  
30 flows under Existing Conditions throughout the period, except during June, when flows would be up  
31 to 28% greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized*  
32 *in the Fish Analysis*).

33 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would nearly always be similar to or  
34 greater than flows under Existing Conditions throughout the period, except in critical years during  
35 August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally greater during  
37 April through June (up to 149% greater), and lower during July and August (up to 51% lower)  
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

39 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
40 under Existing Conditions during April and June and lower by up to 52% during May, July, and  
41 August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
2 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A.

### 3 *Water Temperature*

4 The percentage of months below 68°F water temperature threshold for the April through August  
5 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
6 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful  
7 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear  
8 Creek.

9 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
10 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
11 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
12 temperature-related effects in these rivers during the April through November period.

13 Collectively, these results indicate that the impact would be less than significant because Alternative  
14 3 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all  
15 rivers examined during the April through August spawning period under Alternative 3 would  
16 generally be similar to or greater than flows under the Existing Conditions, except during summer  
17 months in the Sacramento, Feather, and American rivers. Lower flows during these months in these  
18 rivers would not be of sufficient magnitude or frequency to cause a biologically meaningful effect on  
19 threadfin shad. The percentage of months outside all temperature thresholds are generally lower  
20 under Alternative 3 than under the Existing Conditions, indicating that there would be a net  
21 temperature benefit of Alternative 3 to threadfin shad.

### 22 **Largemouth Bass**

23 In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
24 largemouth bass relative to NAA.

### 25 **Flows**

26 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
27 Clear Creek were examined during the March through June largemouth bass spawning period.  
28 Lower flows could reduce the quantity and quality of instream spawning habitat.

29 In the Sacramento River upstream of Red Bluff, flows under A3\_LLTP would generally be similar to or  
30 greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
31 *utilized in the Fish Analysis*).

32 In the Trinity River below Lewiston Reservoir, flows under A3\_LLTP would generally be similar to or  
33 greater than flows under NAA during March through June except in above normal water years  
34 during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 In Clear Creek at Whiskeytown Dam, flows under A3\_LLTP would generally be similar to or greater  
36 than flows under NAA during March through June except in below normal years during March (6%  
37 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

38 In the Feather River at Thermalito Afterbay, flows under A3\_LLTP would be substantially greater (up  
39 to 162% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM II Model*  
40 *Results utilized in the Fish Analysis*).

1 In the American River at Nimbus Dam, flows under A3\_LLT would be similar to flows under NAA  
2 except in March dry and critical years (7% and 8%, respectively). Flows during May and June under  
3 A3\_LLT would generally be up to 31% greater than flows under NAA (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*).

5 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
6 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
7 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

### 8 **Water Temperature**

9 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
10 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
11 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
12 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear  
13 Creek.

14 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
15 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
16 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
17 temperature-related effects in these rivers during the March through June period.

18 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
19 Alternative 3 would not cause a substantial reduction spawning habitat. Flows in all rivers examined  
20 during the year under Alternative 3 are generally similar to or greater than flows under NAA in most  
21 months. Flows from July through September are generally lower in the Feather River high flow  
22 channel and in the American River below Nimbus Dam, although these reductions would not be  
23 biologically meaningful to the largemouth bass population. The percentage of months outside all  
24 temperature thresholds examined in the Feather River under Alternative 3 are generally similar to  
25 or lower than under NAA.

26 **CEQA Conclusion:** In general, Alternative 3 would reduce the quality and quantity of upstream  
27 habitat conditions for largemouth bass relative to the Existing Conditions.

### 28 **Flows**

29 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
30 Clear Creek were examined during the March through June largemouth bass spawning period.  
31 Lower flows could reduce the quantity and quality of instream spawning habitat.

32 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to or  
33 greater than flows under Existing Conditions during March through June, except in wet years during  
34 May (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
36 greater than flows under Existing Conditions during March through June, except in below normal  
37 years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*  
38 *Model Results utilized in the Fish Analysis*).

39 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would be similar to or greater than flows  
40 under Existing Conditions during March through June regardless of water year type (Appendix 11C,  
41 *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
2 greater (up to 149% greater) than flows under Existing Conditions during March through June,  
3 except in below normal years during March (33% lower) and in wet years during May (30% lower)  
4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to or greater  
6 than flows under Existing Conditions during March, April, and June with some exceptions (up to  
7 39% lower). Flows under A3\_LLT in May would generally be up to 25% lower than those under  
8 Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
10 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
11 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
12 during the period relative to Existing Conditions.

### 13 **Water Temperature**

14 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
15 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
16 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
17 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear  
18 Creek.

19 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
20 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
21 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
22 temperature-related effects in these rivers during the March through June period.

23 Collectively, these results indicate that the impact would be less than significant because Alternative  
24 3 would not cause a substantial reduction in largemouth bass habitat. No mitigation is necessary.

### 25 **Sacramento Tule Perch**

26 In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
27 Sacramento tule perch relative to NAA.

### 28 **Flows**

29 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
30 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
31 reduce the quantity and quality of instream habitat available for rearing.

32 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT generally be similar to flows  
33 under NAA during January through April, June, July, and December, greater by up to 33% during  
34 May and October, and lower by up to 43% during August, September, and November (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
37 greater than flows under NAA throughout the period with some exceptions (up to 11% lower)  
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
2 than flows under NAA throughout the year, with some exceptions (up to 37% lower) (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be greater during  
5 April through June and October through November (up to 72% greater) and lower (up to 84%) than  
6 flows under NAA during July through September (Appendix 11C, *CALSIM II Model Results utilized in*  
7 *the Fish Analysis*).

8 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
9 under NAA during January through April and November through December, greater by up to 31%  
10 during May, June and October, and lower by up to 47% during July through November (Appendix  
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
13 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
14 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

### 15 **Water Temperature**

16 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-  
17 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,  
18 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds  
19 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water  
20 temperatures were not modeled in the San Joaquin River or Clear Creek.

21 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
22 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
23 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
24 temperature-related effects in these rivers throughout the year.

25 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
26 Alternative 3 would not cause a substantial reduction in upstream habitat for Sacramento tule  
27 perch. Flows under Alternative 3 in all rivers examined throughout the year are generally similar to  
28 or greater than flows under NAA, except during summer months in the Feather and American rivers.  
29 These reductions in flows, however, would not cause an overall biologically meaningful effect on  
30 Sacramento tule perch. The percentages of months outside all temperature thresholds are generally  
31 lower under Alternative 3 than under NAA.

32 **CEQA Conclusion:** In general, Alternative 3 would not affect the quality and quantity of upstream  
33 habitat conditions for Sacramento tule perch relative to the Existing Conditions.

### 34 **Flows**

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
36 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
37 reduce the quantity and quality of instream habitat available for rearing.

38 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
39 flows under Existing Conditions during January, March, April, July, September, and December,  
40 greater by up to 30% during February, May, June, and October, and lower by up to 24% during  
41 August and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A3\_LLTP would generally be similar to  
2 flows under Existing Conditions during March through May and July through September, greater by  
3 up to 61% during January, February, and June, and lower by up to 25% during October and  
4 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In Clear Creek at Whiskeytown Dam, flows under A3\_LLTP would generally be similar to or greater  
6 than flows under Existing Conditions throughout the year, except in critical years during August and  
7 September (17% and 38%, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*).

9 In the Feather River at Thermalito Afterbay, flows under A3\_LLTP would generally be similar to flows  
10 under Existing Conditions during February and November, greater during January, March through  
11 June, October, and December (up to 149% greater), and lower during July through September (up to  
12 51% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the American River at Nimbus Dam, flows under A3\_LLTP would generally be similar to flows  
14 under Existing Conditions during January, April, and June, greater by up to 29% during February,  
15 March, and October, and lower by up to 52% during May, July through September, November, and  
16 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
18 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
19 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
20 during the year relative to Existing Conditions.

### 21 **Water Temperature**

22 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round  
23 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,  
24 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead  
25 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not  
26 modeled in the San Joaquin River or Clear Creek.

27 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
28 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
29 analysis for Alternative 1A.

30 Collectively, these results indicate that the impact would not be significant because Alternative 3  
31 would not cause a substantial reduction in upstream habitat for Sacramento tule perch. No  
32 mitigation is necessary. Flows would be lower during half of the year in the American River.  
33 However, given that flow reductions in other rivers, including the San Joaquin and Stanislaus rivers,  
34 would be minimal, flow reductions in the American River would not cause biologically meaningful  
35 effects to Sacramento tule perch habitat. The percentages of months outside all temperature  
36 thresholds are generally lower under Alternative 3 than under the Existing Conditions.

### 37 **Sacramento-San Joaquin Roach – California Species of Special Concern**

38 In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
39 Sacramento-San Joaquin Roach relative to NAA.

1       **Flows**

2       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3       Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
4       period. Lower flows could reduce the quantity and quality of instream habitat available for  
5       spawning.

6       In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to or  
7       greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
8       *utilized in the Fish Analysis*).

9       In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
10       greater than flows under NAA during March through June except in above normal water years  
11       during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12       In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
13       than flows under NAA during March through June except in below normal years during March (6%  
14       lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15       In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be similar to or  
16       greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
17       *utilized in the Fish Analysis*).

18       In the American River at Nimbus Dam, flows under A3\_LLT would be similar to flows under NAA  
19       except in March dry and critical years (7% and 8%, respectively). Flows during May and June under  
20       A3\_LLT would generally be up to 31% greater than flows under NAA (Appendix 11C, *CALSIM II*  
21       *Model Results utilized in the Fish Analysis*).

22       Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
23       those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
24       analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

25       **Water Temperature**

26       The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
27       Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
28       Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
29       delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
30       River or Clear Creek.

31       Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
32       Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
33       analysis for Alternative 1A.

34       **NEPA Effects:** As described for Alternative 1A, Alternative 3 would not adversely effect on the  
35       quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to  
36       the NAA

37       **CEQA Conclusion:** In general, Alternative 3 would not affect the quality and quantity of upstream  
38       habitat conditions for Sacramento-San Joaquin roach relative to the Existing Conditions.

1       **Flows**

2       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3       Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
4       period. Lower flows could reduce the quantity and quality of instream habitat available for  
5       spawning.

6       In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to or  
7       greater than flows under Existing Conditions during March through June, except in wet years during  
8       May (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9       In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
10       greater than flows under Existing Conditions during March through June, except in below normal  
11       years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*  
12       *Model Results utilized in the Fish Analysis*).

13       In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would be similar to or greater than flows  
14       under Existing Conditions during March through June regardless of water year type (Appendix 11C,  
15       *CALSIM II Model Results utilized in the Fish Analysis*).

16       In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
17       greater (up to 149% greater) than flows under Existing Conditions during March through June,  
18       except in below normal years during March (33% lower) and in wet years during May (30% lower)  
19       (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20       In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to or greater  
21       than flows under Existing Conditions during March, April, and June with some exceptions (up to  
22       39% lower). Flows under A3\_LLT in May would generally be up to 25% lower than those under  
23       Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24       Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
25       those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
26       analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
27       during the period relative to Existing Conditions.

28       **Water Temperature**

29       The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
30       Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
31       Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
32       delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
33       River or Clear Creek.

34       Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
35       Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
36       analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
37       temperature-related effects in these rivers during the March through June period.

38       **Hardhead – California Species of Special Concern**

39       In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
40       hardhead relative to NAA.

1       **Flows**

2       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3       Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
4       could reduce the quantity and quality of instream habitat available for spawning.

5       In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to or  
6       greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*  
7       *utilized in the Fish Analysis*).

8       In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
9       greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*  
10       *utilized in the Fish Analysis*).

11       In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would always to be similar to flows under  
12       NAA throughout the period regardless of water year type (Appendix 11C, *CALSIM II Model Results*  
13       *utilized in the Fish Analysis*).

14       In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
15       greater (up to 162% greater) than flows under NAA throughout the period (Appendix 11C, *CALSIM*  
16       *II Model Results utilized in the Fish Analysis*).

17       In the American River at Nimbus Dam, flows under A3\_LLT would be similar to or greater than flows  
18       under NAA in April and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19       Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
20       those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
21       analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

22       **Water Temperature**

23       The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
24       hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
25       American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
26       spawning success and increased egg and larval stress and mortality. Water temperatures were not  
27       modeled in the San Joaquin River or Clear Creek.

28       Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
29       Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
30       analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
31       temperature-related effects in these rivers throughout the year.

32       **NEPA Effects:** In general, Alternative 3 would not adversely affect the quality and quantity of  
33       upstream habitat conditions for hardhead relative to the NAA.

34       **CEQA Conclusion:** In general, Alternative 3 would not affect the quality and quantity of upstream  
35       habitat conditions for hardhead relative to the Existing Conditions.

36       **Flows**

37       Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
38       Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
39       could reduce the quantity and quality of instream habitat available for spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to or  
2 greater than flows under Existing Conditions throughout the period, except in wet years during May  
3 (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
5 greater than flows under Existing Conditions throughout the period, except in critical years during  
6 May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would be similar to or greater than flows  
8 under Existing Conditions throughout the period regardless of water year type (Appendix 11C,  
9 *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be substantially  
11 greater by up to 149% than flows under Existing Conditions throughout the period, except in wet  
12 years during May (30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the American River at Nimbus Dam, flows under A3\_LLT would be similar to or greater than flows  
14 under Existing Conditions during April, except in above normal years (6% lower). Flows under  
15 A3\_LLT would generally be lower than flows under Existing Conditions, by up to 25%, during May  
16 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
18 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
19 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
20 during the period relative to Existing Conditions.

### 21 **Water Temperature**

22 The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
23 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
24 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
25 spawning success and increased egg and larval stress and mortality. Water temperatures were not  
26 modeled in the San Joaquin River or Clear Creek.

27 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
28 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
29 analysis for Alternative 1A.

### 30 **California Bay Shrimp**

31 **NEPA Effects:** The effect of water operations on spawning habitat of California bay shrimp under  
32 Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
33 AQUA-4). That discussion under delta smelt addresses the type, magnitude and range of impact  
34 mechanisms that are relevant to the aquatic environment and aquatic species. As described for  
35 Alternative 1A, Impact AQUA-4, the effects would not be adverse.

36 **CEQA Conclusion:** The impact of water operations on spawning habitat of California bay shrimp  
37 would be the same as described immediately above. The impacts would be less than significant.

1 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**  
2 **Species of Primary Management Concern**

3 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-  
4 covered species of primary management concern.

5 ***Striped Bass***

6 ***NEPA Effects:*** The discussion under Alternative 3, Impact AQUA-202 for striped bass also addresses  
7 the embryo and initial rearing period. That analysis indicates that there are no adverse effects on  
8 striped bass rearing during that period. Other effects of water operations on rearing habitat for  
9 striped bass under Alternative 3 would be similar to that described for Alternative 1A (see  
10 Alternative 1A, Impact AQUA-203). As described for Alternative 1A, Impact AQUA-203, the effects  
11 would not be adverse.

12 ***CEQA Conclusion:*** As described above the impacts on striped bass rearing habitat would be less  
13 than significant.

14 ***American Shad***

15 ***NEPA Effects:*** The effects of water operations on rearing habitat for striped bass under Alternative 3  
16 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). As  
17 described for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

18 ***CEQA Conclusion:*** As described above the impacts on American shad rearing habitat would be less  
19 than significant.

20 ***Threadfin Shad***

21 ***NEPA Effects:*** The effects of water operations on rearing habitat for threadfin shad under  
22 Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
23 AQUA-203). As described for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

24 ***CEQA Conclusion:*** As described above the impacts on threadfin shad rearing habitat would be less  
25 than significant.

26 ***Largemouth Bass***

27 ***Juveniles***

28 ***Flows***

29 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
30 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
31 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
32 rearing.

33 In the Sacramento River upstream of Red Bluff, flows under A3\_LLTT would generally be similar to  
34 flows under NAA during April, June, and July, greater by up to 33% during May and October, and  
35 lower by up to 43% during August, September, and November (Appendix 11C, *CALSIM II Model*  
36 *Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to  
2 flows under NAA throughout the period, except in critical years during October (6% lower) and wet  
3 years during November (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4 *Analysis*).

5 In Clear Creek at Whiskeytown Dam, April through November flows under A3\_LLT would generally  
6 be similar to or greater than flows under NAA, with some exceptions (up to 37% lower) (Appendix  
7 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be lower (up to  
9 84%) than flows under NAA during July through September and greater during April through June  
10 and October through November (up to 72% greater) (Appendix 11C, *CALSIM II Model Results utilized*  
11 *in the Fish Analysis*).

12 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
13 under NAA during April and November, greater by up to 31% during May, June, and October, and  
14 lower by up to 47% during July through November (Appendix 11C, *CALSIM II Model Results utilized*  
15 *in the Fish Analysis*).

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
17 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
18 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 19 *Water Temperature*

20 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
21 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
22 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
23 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
24 temperatures were not modeled in the San Joaquin River or Clear Creek.

25 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
26 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
27 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
28 temperature-related effects in these rivers during the April through November period.

#### 29 *Adults*

##### 30 *Flows*

31 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
32 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows  
33 could reduce the quantity and quality of instream habitat available for adult rearing.

34 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
35 flows under NAA during January through April, June, July, and December, greater by up to 33%  
36 during May and October, and lower by up to 43% during August, September, and November  
37 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

38 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
39 greater than flows under NAA throughout the period with some exceptions (up to 11% lower)  
40 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
2 than flows under NAA throughout the year, with some exceptions (up to 37% lower) (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be greater during  
5 April through June and October through November (up to 72% greater) and lower (up to 84%) than  
6 flows under NAA during July through September (Appendix 11C, *CALSIM II Model Results utilized in*  
7 *the Fish Analysis*).

8 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
9 under NAA during January through April and November through December, greater by up to 31%  
10 during May, June and October, and lower by up to 47% during July through November (Appendix  
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
13 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
14 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 15 *Water Temperature*

16 The percentage of months above the 86°F water temperature threshold for year-round adult  
17 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
18 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
19 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
20 modeled in the San Joaquin River or Clear Creek.

21 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
22 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
23 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
24 temperature-related effects in these rivers during the year-round period.

25 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
26 Alternative 3 would not cause a substantial reduction in juvenile or adult rearing habitat. Flows in  
27 all rivers examined during the year under Alternative 3 are generally similar to or greater than flows  
28 under NAA in most months. Flows from July through September are generally lower in the Feather  
29 River high flow channel and in the American River below Nimbus Dam, although these reductions  
30 would not be biologically meaningful to the largemouth bass population. The percentage of months  
31 outside all temperature thresholds examined in the Feather River under Alternative 3 are generally  
32 similar to or lower than under NAA.

33 **CEQA Conclusion:** In general, Alternative 3 would reduce the quality and quantity of upstream  
34 habitat conditions for largemouth bass relative to the Existing Conditions.

#### 35 *Juveniles*

##### 36 *Flows*

37 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
38 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
39 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
40 rearing.

1 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
2 flows under Existing Conditions during April and July, greater by up to 30% during May, June, and  
3 October, and lower by up to 24% during August, September, and November (Appendix 11C, *CALSIM*  
4 *II Model Results utilized in the Fish Analysis*).

5 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to  
6 flows under Existing Conditions during April, May, and July through September, greater by up to  
7 28% during June, and lower by up to 25% during October and November (Appendix 11C, *CALSIM II*  
8 *Model Results utilized in the Fish Analysis*).

9 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
10 than flows under Existing Conditions throughout the April through November period, except in  
11 critical years during August and September (17% to 38% lower, respectively) (Appendix 11C,  
12 *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be similar to flows  
14 under Existing Conditions during November, lower during July through September (up to 51%  
15 lower), and greater during April through June and October (up to 149% greater) (Appendix 11C,  
16 *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
18 under Existing Conditions during April and June, greater by up to 29% during October, and lower by  
19 up to 52% during May, July through September, and November (Appendix 11C, *CALSIM II Model*  
20 *Results utilized in the Fish Analysis*).

21 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
22 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
23 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
24 during the period relative to Existing Conditions.

#### 25 *Water Temperature*

26 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
27 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
28 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
29 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
30 temperatures were not modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
32 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
33 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
34 temperature-related effects in these rivers during the April through November period.

#### 35 *Adults*

##### 36 *Flows*

37 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
38 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower  
39 flows could reduce the quantity and quality of instream habitat available for adult rearing.

1 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
2 flows under Existing Conditions during January, March, April, July, September, and December,  
3 greater by up to 30% during February, May, June, and October, and lower by up to 24% during  
4 August and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to  
6 flows under Existing Conditions during March through May and July through September, greater by  
7 up to 61% during January, February, and June, and lower by up to 25% during October and  
8 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
10 than flows under Existing Conditions throughout the year, except in critical years during August and  
11 September (17% and 38%, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
12 Analysis*).

13 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be similar to flows  
14 under Existing Conditions during February and November, greater during January, March through  
15 June, October, and December (up to 149% greater), and lower during July through September (up to  
16 51% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
18 under Existing Conditions during January, April, and June, greater by up to 29% during February,  
19 March, and October, and lower by up to 52% during May, July through September, November, and  
20 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
22 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
23 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
24 during the period relative to Existing Conditions.

#### 25 *Water Temperature*

26 The percentage of months above the 86°F water temperature threshold for year-round adult  
27 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
28 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
29 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
30 modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
32 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
33 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
34 temperature-related effects in these rivers during the April through November period.

35 Collectively, these results indicate that the impact would not be significant because Alternative 3  
36 would not cause a substantial reduction in largemouth bass habitat. No mitigation is necessary.  
37 Flows would be lower during half of the year-round adult rearing period in the American River.  
38 However, given that flow reductions in other rivers, including the San Joaquin and Stanislaus rivers,  
39 would be minimal, flow reductions in the American River would not cause biologically meaningful  
40 effects to largemouth bass habitat. The percentages of months outside all temperature thresholds  
41 are generally lower under Alternative 3 than under the Existing Conditions.

1 **Sacramento Tule Perch**

2 **NEPA Effects:** The effects of water operations on rearing habitat for Sacramento tule perch under  
3 Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
4 AQUA-5). That discussion under delta smelt addresses the type, magnitude and range of impact  
5 mechanisms that are relevant to the aquatic environment and aquatic species. As described for  
6 Alternative 1A, Impact AQUA-5, the effects would not be adverse.

7 **CEQA Conclusion:** As described above the impacts on Sacramento tule perch rearing habitat would  
8 be less than significant.

9 **Sacramento-San Joaquin Roach**

10 In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
11 Sacramento-San Joaquin Roach relative to NAA.

12 *Flows*

13 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
14 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
15 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
16 rearing.

17 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
18 flows under NAA during January through April, June, July, and December, greater by up to 33%  
19 during May and October, and lower by up to 43% during August, September, and November  
20 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to or  
22 greater than flows under NAA throughout the period with some exceptions (up to 11% lower)  
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
25 than flows under NAA throughout the year, with some exceptions (up to 37% lower) (Appendix 11C,  
26 *CALSIM II Model Results utilized in the Fish Analysis*).

27 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be greater during  
28 April through June and October through November (up to 72% greater) and lower (by up to 84%)  
29 than flows under NAA during July through September (Appendix 11C, *CALSIM II Model Results*  
30 *utilized in the Fish Analysis*).

31 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
32 under NAA during January through April and November through December, greater by up to 31%  
33 during May, June and October, and lower by up to 47% during July through November (Appendix  
34 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
36 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
37 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

1 *Water Temperature*

2 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
3 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
4 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing  
5 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San  
6 Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
8 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
9 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
10 temperature-related effects in these rivers throughout the year.

11 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
12 Alternative 3 would not cause a substantial reduction in rearing habitat. Flows under Alternative 3  
13 in all rivers examined throughout the year are generally similar to or greater than flows under NAA,  
14 except during summer months in the Feather and American rivers, although these reductions would  
15 not be biologically meaningful to the roach population. The percentage of months outside  
16 temperature thresholds is generally similar to or lower under Alternative 3 than under NAA.

17 **CEQA Conclusion:** In general, Alternative 3 would not affect the quality and quantity of upstream  
18 habitat conditions for Sacramento-San Joaquin roach relative to the Existing Conditions.

19 *Flows*

20 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
21 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
22 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
23 rearing.

24 In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally be similar to  
25 flows under Existing Conditions during January, March, April, July, September, and December,  
26 greater by up to 30% during February, May, June, and October, and lower by up to 24% during  
27 August and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 In the Trinity River below Lewiston Reservoir, flows under A3\_LLT would generally be similar to  
29 flows under Existing Conditions during March through May and July through September, greater by  
30 up to 61% during January, February, and June, and lower by up to 25% during October and  
31 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
33 than flows under Existing Conditions throughout the year, except in critical years during August and  
34 September (17% and 38%, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
35 Analysis*).

36 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be similar to flows  
37 under Existing Conditions during February and November, greater during January, March through  
38 June, October, and December (up to 149% greater), and lower during July through September (up to  
39 51% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

40 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
41 under Existing Conditions during January, April, and June, greater by up to 29% during February,

1 March, and October, and lower by up to 52% during May, July through September, November, and  
2 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
4 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
5 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
6 during the period relative to Existing Conditions.

#### 7 *Water Temperature*

8 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
9 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
10 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced  
11 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.  
12 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

13 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
14 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
15 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
16 temperature-related effects in these rivers during the April through November period.

17 Collectively, these results indicate that the impact would not be significant because Alternative 3  
18 would not cause a substantial reduction in Sacramento-San Joaquin roach habitat. No mitigation is  
19 necessary. Flows would be lower during half of the year-round adult rearing period in the American  
20 River. However, given that flow reductions in other rivers, including the San Joaquin and Stanislaus  
21 rivers, would be minimal, flow reductions in the American River would not cause biologically  
22 meaningful effects to roach habitat. The percentages of months outside all temperature thresholds  
23 are generally lower under Alternative 3 than under the Existing Conditions.

#### 24 **Hardhead**

25 In general, Alternative 3 would not affect the quality and quantity of upstream habitat conditions for  
26 hardhead relative to NAA.

#### 27 **Flows**

28 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
29 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
30 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
31 adult rearing.

32 In the Sacramento River upstream of Red Bluff, flows under A3\_LL1T would generally be similar to  
33 flows under NAA during January through April, June, July, and December, greater by up to 33%  
34 during May and October, and lower by up to 43% during August, September, and November  
35 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the Trinity River below Lewiston Reservoir, flows under A3\_LL1T would generally be similar to or  
37 greater than flows under NAA throughout the period with some exceptions (up to 11% lower)  
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A3\_LLT would generally be similar to or greater  
2 than flows under NAA throughout the year, with some exceptions (up to 37% lower) (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Feather River at Thermalito Afterbay, flows under A3\_LLT would generally be greater during  
5 April through June and October through November (up to 72% greater) and lower (up to 84%) than  
6 flows under NAA during July through September (Appendix 11C, *CALSIM II Model Results utilized in*  
7 *the Fish Analysis*).

8 In the American River at Nimbus Dam, flows under A3\_LLT would generally be similar to flows  
9 under NAA during January through April and November through December, greater by up to 31%  
10 during May, June and October, and lower by up to 47% during July through November (Appendix  
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
13 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
14 analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

#### 15 *Water Temperature*

16 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for year-  
17 round juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather,  
18 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
19 rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in  
20 the San Joaquin River or Clear Creek.

21 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
22 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
23 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
24 temperature-related effects in these rivers throughout the year.

25 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
26 Alternative 3 would not cause a substantial reduction in rearing habitat. Flows under Alternative 3  
27 in all rivers examined throughout the year are generally similar to or greater than flows under NAA,  
28 except during summer months in the Feather and American rivers. These reductions in flows,  
29 however, would not cause an overall biologically meaningful effect on hardhead. The percentages of  
30 months outside all temperature thresholds are generally lower under Alternative 3 than under NAA.

31 **CEQA Conclusion:** In general, Alternative 3 would not affect the quality and quantity of upstream  
32 habitat conditions for hardhead relative to the Existing Conditions.

#### 33 *Flows*

34 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
35 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
36 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
37 adult rearing. In the Sacramento River upstream of Red Bluff, flows under A3\_LLT would generally  
38 be similar to flows under Existing Conditions during January, March, April, July, September, and  
39 December, greater by up to 30% during February, May, June, and October, and lower by up to 24%  
40 during August and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A3\_LLТ would generally be similar to  
2 flows under Existing Conditions during March through May and July through September, greater by  
3 up to 61% during January, February, and June, and lower by up to 25% during October and  
4 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In Clear Creek at Whiskeytown Dam, flows under A3\_LLТ would generally be similar to or greater  
6 than flows under Existing Conditions throughout the year, except in critical years during August and  
7 September (17% and 38%, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*).

9 In the Feather River at Thermalito Afterbay, flows under A3\_LLТ would generally be similar to flows  
10 under Existing Conditions during February and November, greater during January, March through  
11 June, October, and December (up to 149% greater), and lower during July through September (up to  
12 51% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the American River at Nimbus Dam, flows under A3\_LLТ would generally be similar to flows  
14 under Existing Conditions during January, April, and June, greater by up to 29% during February,  
15 March, and October, and lower by up to 52% during May, July through September, November, and  
16 December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 3 would be about the same as  
18 those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The  
19 analysis for Alternative 1A indicates that there would be small to moderate reductions in flows  
20 during the period relative to Existing Conditions.

#### 21 *Water Temperature*

22 The percentage of months in which year-round in-stream temperatures would be outside of the  
23 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was  
24 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures  
25 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.  
26 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

27 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under  
28 Alternative 3 would be the same as those under Alternative 1A. For a discussion of the topic see the  
29 analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
30 temperature-related effects in these rivers during the April through November period.

31 Collectively, these results indicate that the impact would be significant because Alternative 3 would  
32 cause a substantial reduction in hardhead habitat. No mitigation is necessary. Flows would be lower  
33 during half of the year-round juvenile and adult rearing period in the American River. However,  
34 given that flow reductions in other rivers, including the San Joaquin and Stanislaus rivers, would be  
35 minimal, flow reductions in the American River would not cause biologically meaningful effects to  
36 hardhead habitat. The percentages of months outside both temperature thresholds are generally  
37 lower under Alternative 3 than under the Existing Conditions.

#### 38 **California Bay Shrimp**

39 **NEPA Effects:** The effect of water operations on rearing habitat of California bay shrimp under  
40 Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
41 AQUA-5). That discussion under delta smelt addresses the type, magnitude and range of impact

1 mechanisms that are relevant to the aquatic environment and aquatic species. As described for  
2 Alternative 1A, Impact AQUA-5, the effects would not be adverse.

3 **CEQA Conclusion:** As described above the impacts on California bay shrimp rearing habitat would  
4 be less than significant.

5 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**  
6 **Aquatic Species of Primary Management Concern**

7 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-  
8 covered species of primary management concern.

9 **Striped Bass**

10 **NEPA Effects:** Monthly flows in the Sacramento River downstream of the north Delta intakes would  
11 decrease (7–13% for NAA) under Alternative 3 during the adult striped bass migration. Sacramento  
12 River flows are highly variable interannually, and striped bass are still able to migrate upstream the  
13 Sacramento River during lower flow years. Overall, the effect of reduced Sacramento flows under  
14 Alternative 3 would not be adverse for striped bass.

15 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
16 significant because the changes in flow (15–21% lower compared to Existing Conditions) would not  
17 interfere substantially with movement of pre-spawning adult striped bass through the Delta. No  
18 mitigation would be required.

19 **American Shad**

20 **NEPA Effects:** Flows in the Sacramento River below the north Delta diversion facilities would be  
21 lower than NAA during March-May. Monthly flows on average would be 7–16% less than NAA when  
22 climate change effects are accounted for. Flows from the San Joaquin River at Vernalis would be  
23 unchanged. Sacramento River flows are highly variable interannually, and American shad are still  
24 able to migrate upstream the Sacramento River during lower flow years. Overall, the impact to  
25 American shad migration habitat conditions would not be adverse under Alternative 3.

26 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
27 significant because the changes in flow (15–21% lower compared to Existing Conditions) would not  
28 interfere substantially with movement of American shad from the Delta to upstream spawning  
29 habitat. No mitigation would be required.

30 **Threadfin Shad**

31 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish  
32 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn.  
33 Therefore there is no effect on migration habitat conditions.

34 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
35 significant because flow changes in the Delta under Alternative 3 would not alter movement  
36 patterns for threadfin shad and no mitigation would be required.

1       **Largemouth Bass**

2       **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use  
3       the Delta as migration habitat corridor. There would be no effect.

4       **CEQA Conclusion:** As described immediately above, flow changes under Alternative 3 would not  
5       affect largemouth movements within the Delta. No mitigation would be required.

6       **Sacramento Tule Perch**

7       **NEPA Effects:** Similar with largemouth bass, Sacramento tule perch are a non-migratory species and  
8       do not use the Delta as a migration corridor as they are a resident Delta species. There would be no  
9       effect.

10       **CEQA Conclusion:** As described immediately above, flow movements would not affect Sacramento  
11       tule perch movements within the Delta. No mitigation would be required.

12       **Sacramento-San Joaquin Roach**

13       **NEPA Effects:** For Sacramento-San Joaquin roach the overall flows and temperature in upstream  
14       rivers during migration to their spawning grounds would be similar to those described under  
15       Alternative 3, Impact AQUA-202 for spawning. As described for Alternative 3, Impact AQUA-202, the  
16       overall change in flows under Alternative 3 would slightly improve the upstream conditions relative  
17       to NAA. These conditions would not be adverse.

18       **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
19       conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

20       **Hardhead**

21       **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration  
22       to their spawning grounds would be similar to those described under Alternative 3, Impact AQUA-  
23       202 for spawning. As described for Alternative 3, Impact AQUA-202, the overall change in flows  
24       under Alternative 3 would slightly improve the upstream conditions relative to NAA. These  
25       conditions would not be adverse.

26       **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
27       conditions for hardhead would not be significant and no mitigation is required.

28       **California Bay Shrimp**

29       **NEPA Effects:** The effect of water operations on migration conditions of California bay shrimp under  
30       Alternative 3 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
31       AQUA-6). That discussion under delta smelt addresses the type, magnitude and range of impact  
32       mechanisms that are relevant to the aquatic environment and aquatic species. As described for  
33       Alternative 1A, Impact AQUA-6, the effects of Alternative 3 would not be adverse.

34       **CEQA Conclusion:** As described above the impacts on California bay shrimp migration conditions  
35       would be less than significant.

1       **Restoration Measures (CM2, CM4–CM7, and CM10)**

2       The effects of restoration measures under Alternative 3 would be similar for all non-covered  
3       species; therefore, the analysis below is combined for all non-covered species instead of analyzed by  
4       individual species.

5       **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic  
6       Species of Primary Management Concern**

7       Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of construction of  
8       restoration measures on non-covered species of primary management concern. That discussion  
9       under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
10      to the aquatic environment and aquatic species.

11      **NEPA Effects:** The potential effects of the construction of restoration measures under Alternative 3  
12      would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-7). As  
13      described for Alternative 1A, Impact AQUA-7, the effects of Alternative 3 would not be adverse.

14      **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration  
15      measures would be less than significant.

16      **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-  
17      Covered Aquatic Species of Primary Management Concern**

18      **NEPA Effects:** Refer to Impact AQUA-8 under delta smelt a discussion of the effects of contaminants  
19      associated with restoration measures on non-covered species of primary management concern. That  
20      discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
21      are relevant to the aquatic environment and aquatic species. The potential effects of the  
22      construction of contaminants associated with restoration measures under Alternative 3 would be  
23      similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). As described for  
24      Alternative 1A, Impact AQUA-8, the effects of Alternative 3 would not be adverse.

25      **CEQA Conclusion:** As described immediately above, the impacts of contaminants associated with  
26      restoration measures would be less than significant.

27      **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of  
28      Primary Management Concern**

29      Refer to Impact AQUA-9 under delta smelt a discussion of the effects of restored habitat conditions  
30      on non-covered species of primary management concern. That discussion under delta smelt  
31      addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic  
32      environment and aquatic species. Although there are minor differences the effects are similar.

33      **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 3 would be  
34      similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). For a detailed  
35      discussion, please see Alternative 1A, Impact AQUA-8. In addition, see Alternative 1A, Impact AQUA-  
36      207 for a discussion of the different effects on non-covered species of primary management concern.  
37      As described for Alternative 1A, the effects of Alternative 3 would range from slightly beneficial to  
38      beneficial.

39      **CEQA Conclusion:** As described immediately above, the impacts of restored habitat conditions  
40      would range from slightly beneficial to beneficial.

1 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**  
2 **Primary Management Concern (CM12)**

3 **NEPA Effects:** Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of  
4 methylmercury management on non-covered species of primary management concern. That  
5 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that  
6 are relevant to the aquatic environment and aquatic species. The potential effects of methylmercury  
7 management under Alternative 3 would be similar to those described for Alternative 1A (see  
8 Alternative 1A, Impact AQUA-10). As described for Alternative 1A, Impact AQUA-10, the effects of  
9 Alternative 3 would not be adverse.

10 **CEQA Conclusion:** As described immediately above, the impacts of methylmercury management  
11 would be less than significant.

12 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**  
13 **Aquatic Species of Primary Management Concern (CM13)**

14 Refer to Impact AQUA-11 under delta smelt a discussion of the effects of invasive aquatic vegetation  
15 management on non-covered species of primary management concern. That discussion under delta  
16 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the  
17 aquatic environment and aquatic species. The potential effects of invasive aquatic vegetation  
18 management under Alternative 3 would be similar to those described for Alternative 1A (see  
19 Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass)  
20 and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish  
21 which improves their hunting success. Sacramento tule perch also use the cover of aquatic plants in  
22 the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of  
23 invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch.  
24 However, this control will not substantially reduce the ability of the predatory species to hunt and  
25 there will still be many other habitats in which the predatory species can successfully hunt and in  
26 which Sacramento tule perch will thrive.

27 **NEPA Effects:** As described above, the effect on non-covered aquatic species will not be adverse.  
28 Control of invasive aquatic vegetation would not occur within California bay shrimp habitat and  
29 there would be no effect on them.

30 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt a discussion of the effects of invasive  
31 aquatic vegetation management on non-covered species of primary management concern. There are  
32 minor differences and the effects are similar except for predatory species (striped bass and  
33 largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for  
34 predatory fish which improves their hunting success. Control of invasive aquatic vegetation would  
35 not occur within California bay shrimp habitat and there would be no effect on them. Sacramento  
36 tule perch use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun  
37 marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect the  
38 predatory species and Sacramento tule perch. However, this control will not substantially reduce the  
39 ability of the predatory species to hunt and there will still be many other habitats in which the  
40 predatory species can successfully hunt and in which Sacramento tule perch will thrive. Therefore  
41 the impact on them will not be significant and no mitigation is required.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 The effects of restoration measures under Alternative 3 would be similar for all non-covered  
3 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by  
4 individual species.

5 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**  
6 **Species of Primary Management Concern (CM14)**

7 *NEPA Effects:* Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved  
8 oxygen management on non-covered species of primary management concern. The potential effects  
9 of dissolved oxygen management under Alternative 3 would be similar to those described for  
10 Alternative 1A (see Alternative 1A, Impact AQUA-12). For a detailed discussion, please see  
11 Alternative 1A, Impact AQUA-12. California bay shrimp do not occur in this habitat and there would  
12 be no effect on them. As described immediately above, the impacts of oxygen level management  
13 would be beneficial.

14 *CEQA Conclusion:* As described immediately above, the impacts of oxygen level management would  
15 be beneficial.

16 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**  
17 **Species of Primary Management Concern (CM15)**

18 *NEPA Effects:* Refer to Alternative 1A, Impact AQUA-13 under delta smelt a discussion of the effects  
19 of predatory fish (striped bass and largemouth bass) and predator management on non-predatory  
20 fish. That discussion under delta smelt addresses the type, magnitude and range of impact  
21 mechanisms that are relevant to the aquatic environment and aquatic species. The purpose of  
22 predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting  
23 success. This management will have negative effects on predatory fish. However, the numbers of  
24 predatory fish are high and the extent of the habitats in which they hunt is extensive. As described  
25 for Alternative 1A, the effects of this management will not be adverse. California bay shrimp do not  
26 occur in these habitats and there would be no effect on them.

27 Therefore the effects of this management will not be adverse. California bay shrimp do not occur in  
28 these habitats and there would be no effect on them.

29 *CEQA Conclusion:* Refer to Alternative 1A, Impact AQUA-13 under delta smelt a discussion of the  
30 effects of predatory fish and predator management on non-predatory fish. The purpose of predatory  
31 fish management is to reduce the numbers of predatory fish and to reduce their hunting success.  
32 This management will have negative effects on predatory fish. However, the numbers of predatory  
33 fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of  
34 this management will not be significant. No mitigation is required. California bay shrimp do not  
35 occur in these habitats and there would be no effect on them.

36 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**  
37 **Primary Management Concern (CM16)**

38 Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of nonphysical fish  
39 barriers on non-covered species of primary management concern. That discussion under delta smelt  
40 addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic  
41 environment and aquatic species.

1 **NEPA Effects:** The potential effects of nonphysical fish barriers under Alternative 3 would be similar  
2 to those described for Alternative 1A (see Alternative 1A, Impact AQUA-14). For a detailed  
3 discussion, please see Alternative 1A, Impact AQUA-14. The effects would be similar except for  
4 Sacramento-San Joaquin roach and hardhead which are unlikely to be present in their vicinity.  
5 California bay shrimp do not occur in these habitats and there would be no effect on them. As  
6 described for Alternative 1A, the effects would not be adverse.

7 **CEQA Conclusion:** As described immediately above, the impacts of nonphysical fish barriers would  
8 be less than significant.

9 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**  
10 **Primary Management Concern (CM17)**

11 Refer to Impact AQUA-15 under delta smelt for a discussion of the effects of illegal harvest reduction  
12 on non-covered species of primary management concern. That discussion under delta smelt  
13 addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic  
14 environment and aquatic species.

15 **NEPA Effects:** The potential effects of illegal harvest reduction under Alternative 3 would be similar  
16 to those described for Alternative 1A (see Alternative 1A, Impact AQUA-15). California bay shrimp  
17 do not occur in these habitats and there would be no effect on them. As described for Alternative 1A,  
18 the effects would not be adverse.

19 **CEQA Conclusion:** As described immediately above, the impacts of illegal harvest reduction would  
20 be less than significant.

21 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**  
22 **Primary Management Concern (CM18)**

23 **NEPA Effects:** Refer to Impact AQUA-16 under delta smelt for a discussion of the effects of  
24 conservation hatcheries on non-covered species of primary management concern. The potential  
25 effects of conservation hatcheries under Alternative 3 would be similar to those described for  
26 Alternative 1A (see Alternative 1A, Impact AQUA-16). As described for Alternative 1A, there would  
27 be no effect.

28 **CEQA Conclusion:** As described immediately above, conservation hatcheries would have not impact.

29 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**  
30 **of Primary Management Concern (CM19)**

31 **NEPA Effects:** Refer to Impact AQUA-17 under delta smelt for a discussion of the effects of  
32 stormwater treatment on non-covered species of primary management concern. That discussion  
33 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
34 to the aquatic environment and aquatic species. The potential effects of stormwater treatment under  
35 Alternative 3 would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
36 AQUA-17). As described for Alternative 1A, these effects would be beneficial.

37 **CEQA Conclusion:** As described immediately above, the impacts of stormwater management would  
38 be beneficial.

1 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
2 **Aquatic Species of Primary Management Concern (CM21)**

3 Refer to Impact AQUA-18 under delta smelt for a discussion of the effects of removal/relocation of  
4 nonproject diversions on non-covered species of primary management concern. That discussion  
5 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant  
6 to the aquatic environment and aquatic species.

7 **NEPA Effects:** The potential effects of removal/relocation of nonproject diversions under  
8 Alternative 3 would be similar to those described for Alternative 1A (see Alternative 1A, Impact  
9 AQUA-18). For a detailed discussion, please see Alternative 1A, Impact AQUA-18. The effects would  
10 be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch which are  
11 unlikely to be present near these diversions. California bay shrimp do not occur in these habitats  
12 and there would be no effect on them. As described for Alternative 1A, the effects would not be  
13 adverse.

14 **CEQA Conclusion:** As described immediately above, the impacts of removal/relocation of nonproject  
15 diversions would be less than significant.

16 **Upstream Reservoirs**

17 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

18 **NEPA Effects:** Similar to the description for Alternative 1A, this effect would not be adverse because  
19 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 3 would not be  
20 substantially reduced when compared to NAA.

21 **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 3 would reduce the  
22 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be  
23 a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant  
24 impact. These results are primarily caused by four factors: differences in sea level rise, differences in  
25 climate change, future water demands, and implementation of the alternative. The analysis  
26 described above comparing Existing Conditions to Alternative 3 does not partition the effect of  
27 implementation of the alternative from those of sea level rise, climate change and future water  
28 demands using the model simulation results presented in this chapter. However, the increment of  
29 change attributable to the alternative is well informed by the results from the NEPA analysis, which  
30 found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 3, if  
31 adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
32 therefore would not in itself result in a significant impact on coldwater habitat in upstream  
33 reservoirs. This impact is found to be less than significant and no mitigation is required.

### 11.3.4.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)

Alternative 4 would result in the same potential construction impact mechanisms as Alternative 1A; however, there would be two fewer intakes under Alternative 4. Consequently, the intensity and extent of impacts related to the construction of the intakes would be less under Alternative 4 than under Alternative 1A. As a result of having fewer intakes, however, Alternative 4 will also include an expanded Clifton Court Forebay with a new embankment dividing the forebay into a north cell and a south cell along with additional connections and control structures to the Banks and Jones pumping plants. These actions will result in additional construction impacts for Alternative 4 compared to Alternative 1A.

Alternative 4 has a lower maximum diversion capacity (up to 9,000 cfs) from the north Delta area than Alternative 1A (up to 15,000 cfs).

The temporary construction footprint of the three intakes would occupy about 16.21 acres of in-water habitat, while the total permanent in-water footprint would be approximately 12.3 acres (9.5 acres smaller under Alternative 4 than under Alternative 1A). The total length of permanent intakes and the associated bank protection would be approximately 6,360 feet (5,540 feet less than Alternative 1A) (see Table 11-5). Under Alternative 4 there would be five barge locations rather than six under Alternative 1A. One of the five barge landings under Alternative 4 would be in the same location as Alternative 1A while the four would be in different locations. The analysis assumes all of these would operate the same as the landings under Alternative 1A. The effects of the landing construction and operation, including the cargo handling system, are assumed to be the same under Alternative 4 as under Alternative 1A although some barge activities would take place on levees using a barge ramp in conjunction with a crane/excavator barge or a crane or excavator placed on or near the levee. Therefore, all impacts related to construction of the conveyance tunnel and pipelines, and the barge unloading facilities, are considered to be the same. The Sacramento River channel and bank would be affected by construction of the three north Delta intake facilities (Intakes 2, 3, and 5) between RM 44 (south of Freeport) and approximately RM 39 (at the town of Courtland). The locations, dimensions, and construction footprints of the intakes considered in Alternative 4 are provided in Table 11-5.

The number of barge trips required under Alternative 4 would be similar to the estimated 3,000 barge trips under Alternative 1A; although only three intake facilities would be constructed under Alternative 4 compared to five intakes under Alternative 1A additional trips would be required for Clifton Court Forebay construction. Other aspects of in-water construction would be similar under Alternative 4 as described for Alternative 1A, except as they relate to the reduced number of intakes constructed and construction at Clifton Court Forebay under Alternative 4.

New water conveyance facilities of Alternative 4 that would affect the aquatic environment include creating a north and south cell in Clifton Court Forebay by constructing an embankment to separate them, increasing the forebay by 690 acres (to 2,950 acres total) by expanding the south cell to the southeast, and excavating the existing Clifton Court Forebay to expand the storage (Table 3-11). Additionally, three culvert siphons would be constructed under Alternative 4. One would serve as a transition between Tunnel 2 and the expanded Clifton Court Forebay under Italian Slough, one would connect the north cell of the expanded Clifton Court Forebay to a new approach canal to the Banks and Jones Pumping Plants under the south cell of the Forebay, and one would connect the

1 new approach canal to the existing approach canal to Banks Pumping Plant under Byron Highway.  
2 Construction and excavation at Clifton Court Forebay would be done in the dry via installation of  
3 cofferdams for isolation and dewatering of work areas.

4 Alternative 4 also includes different water conveyance operational criteria (Operational Scenario H)  
5 than Alternative 1A (Operational Scenario A), resulting in different patterns of water withdrawals  
6 from the north Delta, and potentially different effects on water quality and aquatic habitat  
7 conditions in the Plan Area. As fully described in Chapter 3, *Description of Alternatives*, Alternative 4  
8 operations incorporate a decision tree process that results in four potential operational sub-  
9 scenarios, depending on the outcome of the decision tree process for spring outflow and Fall X2  
10 operations. The decision tree process will specifically test the need for Fall X2 for delta smelt and  
11 spring outflow for longfin smelt as described in Chapter 3, *Description of Alternatives*. The four  
12 potential operational outcomes of the decision tree are as follows:

- 13 • Scenario H1 – Does not include enhanced spring outflow or Fall X2 requirements.
- 14 • Scenario H2 – includes enhanced spring outflow, but not Fall X2 requirements. This scenario lies  
15 within the range of the other scenarios.
- 16 • Scenario H3 – Does not include enhanced spring outflow, but includes Fall X2 requirements  
17 (similar to Alternative 2A). This scenario lies within the range of the H1 and H4 scenarios.
- 18 • Scenario H4 – Includes both enhanced spring outflow requirements, and Fall X2 requirements.

19 Based on a comparison of the flow effects of H1 and H4, it is concluded that they represent the  
20 bookends for operational effects of Alternative 4 (Appendix 11C, *CALSIM II Model Results utilized in*  
21 *the Fish Analysis, Section 11C.4.3*. As such, H1 and H4, along with Scenario H3, which includes Fall X2  
22 but not enhanced spring outflow, are used as the primary point of comparison for purposes of  
23 evaluating the effects of Alternative 4 because together they represent the end and middle points of  
24 potential effects. The decision tree will be used to determine the actual operational scenario for  
25 Alternative 4 prior to CM1 operations in order to achieve results that are not adverse and are less  
26 than significant. The operations impact analysis compares late long-term (LLT) Alternative 4 results  
27 for Existing Conditions (CEQA) or no action (NEPA) with the range of outcomes from the operational  
28 sub-scenarios (H1–H4), and concludes with a single impact statement for each issue.

## 29 **Delta Smelt**

### 30 **Construction and Maintenance of CM1**

31 The construction and maintenance activities would occur entirely within designated critical habitat.  
32 Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June  
33 during a portion of the in-water construction period for the intake facilities. Small numbers could  
34 also be present in June or July during construction of the barge landings in the east Delta and south  
35 Delta and during construction at Clifton Court Forebay (see Table 11-4).

### 36 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

37 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on delta smelt  
38 or critical habitat would be similar to those described for Alternative 1A (Impact AQUA-1) except  
39 that Alternative 4 would include three intakes compared to five intakes under Alternative 1A, so the  
40 effects would be proportionally less under this alternative. This would convert about 6,360 lineal  
41 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of

1 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
2 shoreline and would require 27.3 acres of dredging. Alternative 4 would use five barge locations  
3 rather than six as under Alternative 1A so those effects would also be proportionally less.

4 Additionally, construction and excavation at Clifton Court Forebay would be done in the dry via  
5 installation of cofferdams for isolation and dewatering of work areas. Implementation of Appendix  
6 3B, *Environmental Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage*  
7 *Plan*, would minimize adverse effects as described for Alternative 1A. Mitigation measures would  
8 also be available to avoid and minimize potential effects. As concluded for Alternative 1A, Impact  
9 AQUA-1, the effect would not be adverse for delta smelt.

10 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-1, the impact of the construction of  
11 the water conveyance facilities on delta smelt or critical habitat would not be significant except for  
12 construction noise associated with pile driving. Potential pile driving impacts would be less than  
13 Alternative 1A because only three intakes would be constructed rather than five. Implementation of  
14 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
15 less than significant.

16 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
17 **of Pile Driving and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
19 Alternative 1A.

20 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
21 **and Other Construction-Related Underwater Noise**

22 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
23 Alternative 1A.

24 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

25 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
26 Alternative 4 would be the same as those described for Alternative 1A (see Impact AQUA-2) except  
27 that only three intakes would need to be maintained under Alternative 4 rather than five under  
28 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the impact would not be adverse for  
29 delta smelt or their designated critical habitat.

30 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-2 for delta smelt, the impact of the  
31 maintenance of water conveyance facilities on delta smelt or critical habitat would not be significant  
32 and no mitigation is required.

1 **Water Operations of CM1**

2 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

3 ***Water Exports from SWP/CVP South Delta Facilities***

4 Alternative 4 would result in lower overall entrainment of delta smelt than the NAA. The predicted  
5 entrainment of larval/juvenile delta smelt at the south Delta export facilities was generally lowest  
6 under Scenario H4 operations, and highest under the NAA and H3/H1 scenarios (Figure 11-4-1).  
7 Each of the Alternative 4 subscenarios would result in lower entrainment of delta smelt in wet and  
8 above-normal water years; however, only H4 provided for lower predicted entrainment in below-  
9 normal and dry water years, and all of the subscenarios had similar entrainment to the NAA in  
10 critical water years.

11 The predicted entrainment of adult delta smelt was generally lower than the NAA under Alternative  
12 4 operations (Figure 11-4-2). This pattern was most pronounced and most similar among  
13 subscenarios in wet and above-normal water years in which predicted entrainment was lowered by  
14 about one-third and one-quarter respectively. The predictions of adult delta smelt entrainment were  
15 lower than, but increasingly similar to, the NAA as modeled hydrology got drier (below-normal, dry,  
16 critical). Estimated entrainment under Scenario H3 would be 0.015 less (20% lower in relative  
17 terms) for adults and 0.019 less (9% lower in relative terms) for the combined juvenile and adult  
18 population compared to NAA (Table 11-4-1). These differences represent 2% or less of the  
19 population.

20 Entrainment losses of delta smelt at the SWP/CVP south Delta facilities are related to OMR flows. All  
21 of the Alternative 4 subscenarios include the same south Delta operational criteria, but the  
22 differences in spring and fall outflow result in minor differences in actual operations, and resultant  
23 minor differences in entrainment effects on delta smelt (Figures 11-4-1 and 11-4-2). Scenario H3  
24 does not include enhanced spring outflow, although it includes stricter south Delta operational  
25 criteria relative to OMR flows as compared to the NAA. Because delta smelt entrainment occurs  
26 primarily in the winter and spring, Scenario H3 represents greatest potential effects of delta smelt  
27 entrainment based on methods that correlate spring OMR flows and delta smelt entrainment.

1 **Table 11-4-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities for**  
2 **Alternative 4 (Scenario H3)**

Water Year	Proportional Entrainment <sup>a</sup>	
	Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A4	NAA vs. A4
<b>Total Population</b>		
Wet	-0.017 (-16%)	-0.043 (-32%)
Above Normal	-0.010 (-6%)	-0.038 (-20%)
Below Normal	0.024 (11%)	-0.006 (-2%)
Dry	0.015 (6%)	-0.004 (-1%)
Critical	0.009 (3%)	0.010 (3%)
All Years	0.002 (1%)	-0.019 (-9%)
<b>Juvenile Delta Smelt (March–June)</b>		
Wet	0.011 (28%)	-0.016 (-24%)
Above Normal	0.011 (14%)	-0.018 (-16%)
Below Normal	0.034 (25%)	0.003 (1%)
Dry	0.024 (13%)	0.004 (2%)
Critical	0.015 (6%)	0.011 (4%)
All Years	0.018 (15%)	-0.005 (-3%)
<b>Adult Delta Smelt<sup>b</sup> (December–March)</b>		
Wet	-0.028 (-40%)	-0.027 (-39%)
Above Normal	-0.021 (-26%)	-0.020 (-25%)
Below Normal	-0.010 (-13%)	-0.008 (-10%)
Dry	-0.009 (-11%)	-0.008 (-10%)
Critical	-0.006 (-9%)	-0.001 (-2%)
All Years	-0.017 (-22%)	-0.015 (-20%)

Shading indicates >5% or more increased entrainment.

Note: Negative values indicate lower entrainment loss under Alternative 4 than under existing biological conditions.

<sup>a</sup> Proportional entrainment index calculated in accordance with USFWS BiOp (U.S. Fish and Wildlife Service 2008a).

<sup>b</sup> Adult proportional entrainment adjusted according to Kimmerer (2011).

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 The impact would be similar in manner to Impact AQUA-3 in Alternative 1A for north Delta intakes,  
6 but possibly lower because Alternative 4 has fewer intakes. Potential entrainment and impingement  
7 risks at the proposed north Delta facilities would be limited since delta smelt rarely occur in the  
8 vicinity of the proposed intake sites (Swanson et al. 2005, 2010; White et al. 2007). The intakes  
9 would be screened to exclude fish larger than approximately 15 mm.

10 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

11 Particle tracking modeling simulated delta smelt larval entrainment at the North Bay Aqueduct. A  
12 total of 38 runs were analyzed under Scenario H3, with each hydroperiod matched to a 20-mm

1 larval delta smelt starting distribution on the basis of Delta outflow. Particle entrainment at the NBA  
2 was low, averaging 1.4% under Scenario H3 compared to 1.9% under NAA, or 25% lower in relative  
3 terms (Table 11-4-2).

4 **Table 11-4-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt**  
5 **Entrained by the North Bay Aqueduct under Alternative 4 (Scenario H3) and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A4_LLТ	A4_LLТ vs. EXISTING CONDITIONS	A4_LLТ vs. NAA
1.9	1.9	1.4	-0.52 (-27%)	-0.46 (-25%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario

6

7 ***Predation Associated with Entrainment***

8 Under Alternative 4, pre-screen predation losses at the south Delta facilities would be reduced  
9 commensurate with the reductions in entrainment described above. Predation loss at the north  
10 Delta intakes may occur but would be limited because few delta smelt are anticipated to occur that  
11 far upstream.

12 ***NEPA Effects:*** Delta smelt entrainment under Alternative 4 would not be adverse relative to the  
13 NAA; model predictions indicate that notable reductions in entrainment would occur. Thus,  
14 Alternative 4 is likely to benefit delta smelt due to lower average entrainment and associated  
15 predation losses at the south Delta export facilities coupled with expectations of minimal  
16 entrainment risk at the north Delta facilities and NBA intakes.

17 ***CEQA Conclusion:*** As described above (Table 11-4-1), under Scenario H3 entrainment at the  
18 south Delta SWP/CVP water export facilities averaged across all years would be 0.017 less (a  
19 22% relative decrease) for adult delta smelt, and 0.018 more (a 15% relative increase) for  
20 juvenile delta smelt compared to Existing Conditions. However, the percentage of the  
21 larval/juvenile population affected would be small (<2%). It is worth considering how this  
22 result differs from the NEPA conclusion set forth above. Under the CEQA analysis, Alternative 4  
23 could substantially increase larval/juvenile proportional entrainment when compared to  
24 Existing Conditions. However, as described under Alternative 1A (Impact AQUA-3), this  
25 interpretation of the biological modeling results is likely attributable to different modeling  
26 assumptions for four factors: sea level rise, climate change, future water demands, and  
27 implementation of the alternative. Note that the analysis for larvae and juveniles includes both  
28 OMR flows and X2 as predictors of proportional entrainment; primarily because of sea level rise  
29 assumptions, X2 would be further upstream in the ELT and LLT even with similar water  
30 operations, so that the comparison of Alternative 4 in the ELT and LLT to Existing Conditions is  
31 confounded. Because the action alternative modeling does not partition the effects of  
32 implementation of the alternative from the effects of sea level rise, climate change and future water  
33 demands, the comparison to Existing Conditions may not offer a clear understanding of the impact  
34 of the alternative on the environment.

35 Therefore, the analysis of larval/juvenile delta smelt entrainment at the south Delta SWP/CVP water  
36 export facilities is better informed by the results from the NEPA analysis presented above, which  
37 accounts for sea level rise by considering the NAA in the LLT. When compared to NAA and informed

1 by the NEPA analysis, above, larval-juvenile delta smelt entrainment is generally similar to  
 2 conditions without BDCP (entrainment is reduced by 3%). Proportional entrainment under Scenario  
 3 H1 would be similar to H3, and would be lower under Scenario H4. Entrainment under Scenario H1  
 4 would be similar to Scenario H3 and lower than Existing Conditions while conditions under Scenario  
 5 H4 would further reduce entrainment relative to Scenario H3. Scenarios H1 and H4 represent the  
 6 full range of conditions expected under the four potential outcomes for Alternative 4, and therefore  
 7 entrainment is expected to be reduced under Alternative 4. Pre-screen delta smelt predation losses  
 8 at the south Delta facilities would be no greater and may be lower compared to Existing Conditions  
 9 due to lower overall entrainment. Predation losses at the north Delta intakes would be minimal  
 10 because delta smelt rarely occur in that vicinity. Overall, the impact would be less than significant  
 11 because overall entrainment of delta smelt would be reduced compared to Existing Conditions and  
 12 only a small proportion of the delta smelt population would be affected. No mitigation would be  
 13 required.

14 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
 15 **Delta Smelt**

16 **NEPA Effects:** The effects of operations under Alternative 4 on abiotic spawning habitat would be  
 17 similar as those described for Alternative 1A (Impact AQUA-4). Flows affect the amount of spawning  
 18 habitat available to delta smelt (Hobbs et al. 2005; 2007), although spawning habitat is not known to  
 19 be limited. Alternative 4 would reduce the flows downstream of the north Delta intakes, with the  
 20 reduction being greatest for H1 and H3 (which do not include enhanced spring outflow) and lowest  
 21 for H2 and H4 (which include enhanced spring outflow). However, flow reductions below the north  
 22 Delta intakes are not expected to substantially reduce available spawning habitat under any of the  
 23 operating scenarios for Alternative 4 because implementation of *CM4 Tidal Natural Communities*  
 24 *Restoration* is expected to more than offset any loss of spawning habitat caused by reduced flows  
 25 below the north Delta intakes. This is indicated by the results presented in Appendix 5E of the BDCP  
 26 Effects Analysis (section 5E.4.2.4.4), wherein the habitat suitability index for delta smelt eggs/larvae  
 27 in each subregion of the Plan Area is appreciably greater under the BDCP than under Existing  
 28 Conditions. Therefore, there will be no adverse effect on delta smelt spawning.

29 **CEQA Conclusion:** As described above, operations under Alternative 4 would not reduce abiotic  
 30 spawning habitat availability or change water temperatures for spawning delta smelt under any of  
 31 the proposed flow scenarios. Consequently, the impact would be less than significant, and no  
 32 mitigation is required.

33 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

34 Larval and juvenile delta smelt generally rear throughout the west Delta, Suisun Bay, Suisun Marsh,  
 35 and in Cache Slough. Other areas in the Delta may also be used for rearing. The extent of abiotic  
 36 habitat for delta smelt in the fall (September–December, the older juvenile rearing and maturation  
 37 period) as a function of changes in flows was assessed using a technique based on the method of  
 38 Feyrer and coauthors (2011) (as detailed in *BDCP Effects Analysis –Appendix 5.C, Flow, Section*  
 39 *5C.5.4.5.1 Delta Smelt Fall Abiotic Habitat Index hereby incorporated by reference. BDCP Effects*  
 40 *Analysis –Appendix 5.E Habitat Restoration* presents additional analyses of effects on delta smelt  
 41 related to juvenile habitat).

42 Feyrer and coauthors (2011) demonstrated that X2 in the fall correlates nonlinearly with an index of  
 43 delta smelt abiotic habitat in the West Delta, Suisun Bay, and Suisun Marsh subregions, as well as

1 smaller portions of the Cache Slough, South Delta, and North Delta subregions (see Figure 3 of  
2 Feyrer et al. 2011). Investigations in recent years have indicated that delta smelt occur year-round  
3 in the Cache Slough subregion, including Cache Slough, Liberty Island, and the Sacramento Deep  
4 Water Ship Channel (Baxter et al. 2010; Sommer et al. 2011). Whether the same individuals are  
5 residing in these areas for their full life cycles or different individuals are moving between upstream  
6 and downstream habitats is not known (Sommer et al. 2011). The delta smelt fall abiotic habitat  
7 index is the surface area of water in the west Delta, Suisun Bay, and Suisun Marsh (as well as smaller  
8 portions of the Cache Slough, South Delta, and North Delta subregions) weighted by the probability  
9 of presence of delta smelt based on water clarity (Secchi depth) and salinity (specific conductance)  
10 in the water. Feyrer and coauthors' (2011) method found these two variables to be significant  
11 predictors of delta smelt presence in the fall. They also concluded that water temperature was not a  
12 predictor of delta smelt presence in the fall, although it has been shown to be important during  
13 summer months (Nobriga et al. 2008).

14 Investigations in recent years have indicated that delta smelt occur year-round in the Cache Slough  
15 subregion, including Cache Slough, Liberty Island, and the Sacramento Deep Water Ship Channel  
16 (Baxter et al. 2010; Sommer et al. 2011). The degree of individual movement between upstream and  
17 downstream habitats has not been confirmed (Sommer et al. 2011), although emerging evidence  
18 suggests that a substantial fraction of the fish occurring in the upstream areas are residing there  
19 throughout the year (Hobbs in prep.).

20 Disagreements regarding the relationship between Fall X2 and delta smelt abundance prompted the  
21 development of the Fall X2 decision tree, which will use information generated by adaptive  
22 management processes under BDCP to inform operational rules for CM1 in the fall months.

23 The intent of the Fall X2 decision tree is to benefit delta smelt rearing habitat through some  
24 combination of outflow and physical habitat restoration. The decision tree branches represent  
25 several modeled possibilities for how operations and habitat restoration could combine to provide  
26 habitat benefits for this species. Scenarios H1 and H4 bracket a range of fall outflow operations that,  
27 based on current understanding, might be required. Scenarios H3 and H4 include Fall X2 per the  
28 2008 Delta Smelt BiOp while Scenarios H1 and H2 do not. These differences drive the results  
29 presented below. Habitat restoration (CM4), particularly in the Suisun Marsh, West Delta, and Cache  
30 Slough ROAs is intended to improve rearing habitat suitability per unit of flow (see Results below),  
31 particularly by supplementing food production.

32 Analysis of larval and juvenile delta smelt habitat suitability in the restoration opportunity areas  
33 (ROAs) demonstrated that *CM4 Tidal Natural Communities Restoration* has the potential to result in  
34 considerably more suitable delta smelt habitat than currently exists.

35 Under Scenarios H3 and H4 operations (which include Fall X2), if it is assumed that habitat  
36 restoration will provide similar environmental conditions and occupancy to adjacent existing tidal  
37 areas, the abiotic habitat index would be 28-30% greater compared to NAA (Table 11-4-3). The  
38 greatest increase (34-38% higher compared to NAA) could occur in below normal and dry years.  
39 These estimates are based on an assumption that 100% of the newly restored habitat in Suisun  
40 Marsh, West Delta, and Cache Slough ROAs would be utilized by rearing delta smelt, and that food  
41 production benefits of the new habitat would be high. With fully effective BDCP habitat restoration  
42 actions, the abiotic habitat index under Scenario H1 would be similar (3% lower) than under the  
43 NAA, and with ineffective restoration, H1 would result in a 21% reduction in fall abiotic habitat  
44 compared to NAA.

1 **NEPA Effects:** The BDCP includes both water operations and habitat restoration components that  
2 are expected to provide habitat benefits to delta smelt. As described above, the contribution of  
3 operations to delta smelt habitat can be estimated on the basis of Delta outflow. The benefits of  
4 restored habitat for this species will depend on the success of restoration in creating physical  
5 habitat for smelt and in fostering ecological conditions that favor good feeding conditions and  
6 production of food upon which smelt can feed. The magnitude of restored habitat benefits is  
7 uncertain. As such, restoration success will have to be assessed empirically during the term of the  
8 BDCP permit. In the absence of restored habitat, or in the event BDCP habitat restoration does not  
9 produce the desired benefits, the average fall abiotic habitat index across all years would be similar  
10 to NAA in the Scenarios that include augmented fall outflow (2% greater under Scenario H3 and 3%  
11 greater under Scenario H4) (Figure 11-4-4, Table 11-4-3). Under Scenarios H1 and H2, which do not  
12 include Fall X2, the abiotic habitat index would be 21% (H1) and XX% (H2) lower than NAA. If BDCP  
13 habitat restoration produces large benefits for delta smelt, then the extent of suitable abiotic habitat  
14 and other habitat measures would be correspondingly higher in all scenarios, and the net benefits  
15 might exceed the NAA in the low outflow scenario.

16 Through the term of the permit, BDCP water operations will be subject to adjustment via adaptive  
17 management, beginning with the decision tree process in the years prior to CM1 operations.  
18 Recognizing the uncertainties of habitat restoration and disagreement regarding the importance of  
19 fall outflow augmentation to delta smelt, the Decision Tree phase of adaptive management is  
20 designed to allow for further evaluation of the need for fall outflow, concurrent with early  
21 evaluation of the level of benefits of BDCP habitat restoration for delta smelt. The decision tree  
22 process will inform a decision made at the time CM1 operations begin regarding the parameters of  
23 water operations. That decision will, on the basis of what has been learned about the effects of  
24 outflow and habitat restoration, identify CM1 operations that are expected to meet the delta smelt  
25 population growth and abundance objectives. Those operations will ensure the impacts of water  
26 operations on rearing habitat for delta smelt are not adverse and support a contribution to recovery  
27 of this species. Following this decision, the Adaptive Management Program will continue to evaluate  
28 the effects of water operations and habitat restoration on the delta smelt population, including  
29 making adjustments as appropriate to improve water supply reliability.

30 **CEQA Conclusion:** Without habitat restoration, the average fall abiotic habitat index for Alternative  
31 4 would be greater than Existing Conditions for Scenario H3 (25% greater) and Scenario H4 (26%  
32 greater), and reduced 4% for Scenario H1 (Table 11-4-3). However, with habitat restoration under  
33 Alternative 4 (Scenarios H1-H4) the average fall abiotic habitat index would increase 21% under  
34 Scenario H1 and increase 57-59% under Scenarios H3 and H4 (Table 11-4-3, Figure 11-4-3).

35 Note that the CEQA analysis predicts a greater increase in the abiotic habitat index relative to  
36 baseline than the NEPA analysis. It is unclear whether this increase compared to Existing Conditions  
37 is a function of project operations under the alternative, or attributable to differences in modeling  
38 assumptions (Existing Conditions does not include Fall X2). The NEPA analysis is a better approach  
39 for isolating the effect of the alternative from the effects of sea level rise, climate change, future  
40 water demands, and implementation of required actions such as the Fall X2 requirement.

41 When compared to the NAA and informed by the NEPA analysis, the average delta smelt abiotic  
42 habitat index under Alternative 4 without restoration would be 21% lower under Scenario H1 and  
43 similar to baseline with Fall X2 under Scenarios H3 and H4. With restoration, the average abiotic  
44 index would be 3% lower under Scenario H1 and 28-30% greater under Scenarios H3 and H4  
45 compared to NAA.

1 Overall, there would be a beneficial impact on the species compared to existing conditions without  
 2 Fall X2, primarily from implementation of the restoration. The benefits of restored habitat for this  
 3 species will depend on the success of restoration in creating physical habitat for smelt and in  
 4 fostering ecological conditions that favor good feeding conditions and production of food upon  
 5 which smelt can feed. The magnitude of restored habitat benefits is uncertain. As described above in  
 6 the NEPA analysis, BDCP water operations will be subject to adjustment via adaptive management,  
 7 in order to ensure the impacts of water operations on rearing habitat for delta smelt are not  
 8 significant and to support a contribution to recovery of this species. The Adaptive Management  
 9 Program with the decision tree process will evaluate the effects of water operations and habitat  
 10 restoration on the delta smelt population, including adjustments as appropriate to improve water  
 11 supply reliability.

12 Therefore, since Alternative 4 would benefit rearing delta smelt because the abiotic habitat index  
 13 under all the flow scenarios would be greater than Existing Conditions, the impact is less than  
 14 significant. No mitigation would be required.

15 **Table 11-4-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 4 (Scenarios**  
 16 **H3, H1, and H4) and Existing Biological Conditions Scenarios, with and without Habitat Restoration,**  
 17 **Averaged by Prior Water Year Type**

Water Years	EXISTING CONDITIONS vs. A4			NAA vs. A4		
	H3	H1	H4	H3	H1	H4
<b>Without Restoration</b>						
All	1,002 (25%)	-140 (-3.5%)	1,034 (26.0%)	116 (2%)	-1,022 (-21%)	153 (3%)
Wet	2,183 (46%)	-657 (-14.0%)	2,192 (46.6%)	-13 (0%)	-2,853 (-41%)	-4 (0%)
Above Normal	1,718 (45%)	13 (0.3%)	1,739 (45.5%)	50 (1%)	-1,655 (-30%)	72 (1%)
Below Normal	-5 (0%)	32 (0.8%)	156 (3.8%)	233 (6%)	180 (5%)	303 (8%)
Dry	222 (6%)	267 (7.5%)	282 (7.9%)	313 (9%)	358 (10%)	373 (11%)
Critical	24 (1%)	27 (0.9%)	33 (1.1%)	23 (1%)	26 (1%)	33 (1%)
<b>With Restoration</b>						
All	2,335 (59%)	821 (20.6%)	2,289 (57.5%)	1,449 (30%)	-155 (-3%)	1,453 (28%)
Wet	4,073 (87%)	339 (7.2%)	3,909 (83.1%)	1,876 (27%)	-1,857 (-27%)	1,712 (25%)
Above Normal	3,228 (84%)	1,057 (27.6%)	3,250 (85.0%)	1,560 (28%)	-610 (-11%)	1,583 (29%)
Below Normal	1,222 (30%)	1,152 (27.8%)	1,305 (31.5%)	1,370 (34%)	1,300 (33%)	1,453 (36%)
Dry	1,216 (34%)	1,243 (34.9%)	1,268 (35.6%)	1,308 (38%)	1,334 (38%)	1,359 (39%)
Critical	729 (24%)	630 (21.1%)	575 (19.3%)	728 (24%)	630 (21%)	575 (19%)

Note: Negative values indicate lower habitat indices under alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

18

19 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

20 From December to March, many mature delta smelt migrate upstream from brackish rearing areas  
 21 in and around Suisun Bay and the confluence of the Sacramento and San Joaquin Rivers (U.S. Fish  
 22 and Wildlife Service 2008a; Sommer et al. 2011). The initiation of migration is associated with  
 23 pulses of freshwater inflow, which are turbid, cool, and less saline (Grimaldo et al. 2009). Changes in  
 24 flow under Alternative 4 could change turbidity, but is not expected to result in changes in water  
 25 temperatures or pulses of local rainwater into the Delta. As described above in Impact AQUA-4, in-  
 26 Delta water temperatures would not change in response to Alternative 4 flows. The modeling results

1 indicate no biologically meaningful changes in water temperature within the Delta under Alternative  
2 4 and no substantial changes in the number of stressful or lethal condition days for juveniles.

3 Turbid water is an important habitat characteristic for delta smelt (Nobriga et al. 2008; Feyrer et al.  
4 2011), and has been correlated to long-term changes in delta smelt abundance or survival either by  
5 itself or in combination with other factors (Thomson et al. 2010; Miller et al. 2012). Therefore, it is  
6 assumed that turbidity is an attribute of critical importance to delta smelt larvae, juveniles, and  
7 adults. Operation of the north Delta intakes (*CM1 Water Facilities and Operation*) is estimated to  
8 result in around 8 to 9% less sediment entering the Plan Area from the Sacramento River, the main  
9 source of sediment for the Delta and downstream subregions. In addition, sediment could be  
10 accreted (captured) in the ROAs (*CM4 Tidal Natural Communities Restoration*). Notching the  
11 Fremont Weir (*CM2 Yolo Bypass Fisheries Enhancements*) will also direct more Sacramento River  
12 water and sediment into the Bypass. These actions could limit sediment supply to areas currently  
13 important to delta smelt, such as Suisun Bay, which would result in less seasonal deposition of  
14 sediment that could be resuspended by wind-wave action to make/keep the overlying water column  
15 turbid. Therefore, there is a potential for a slight increase in water clarity, and a corresponding  
16 reduction in habitat quality for delta smelt. However, Alternative 4 is not expected to affect  
17 suspended sediment concentration during the first flush of precipitation that cues delta smelt  
18 migration. As such, turbidity cues associated with adult delta smelt migration should not change.  
19 With regard to suspended sediment concentrations at other times of the year, any effect will be  
20 minimized through the reintroduction of sediment collected at the north Delta intakes into tidal  
21 natural communities restoration projects (CM4), consistent with the Environmental Commitment  
22 addressing Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material.

23 **NEPA Effects:** Alternative 4 may decrease sediment supply to the estuary by 8 to 9 percent, with the  
24 potential for decreased habitat suitability for delta smelt in some locations.

25 **CEQA Conclusion:** As described above, operations for all flow operating scenarios under Alternative  
26 4 would not substantially alter the turbidity cues associated with winter flush events that may  
27 initiate migration, nor would there be appreciable changes in water temperatures. Consequently, the  
28 impact on adult delta smelt migration conditions would be less than significant, and no mitigation is  
29 required.

### 30 **Restoration Measures (CM2, CM4–CM7, and CM10)**

31 Alternative 4 has the same restoration measures as Alternative 1A. Because no substantial  
32 differences in impacts of tidal habitat restoration on delta smelt are anticipated anywhere in the  
33 affected environment under Alternative 4 compared to those described in detail for Alternative 1A,  
34 the effects of restoration measures described for delta smelt under Alternative 1A (Impacts AQUA-7  
35 through AQUA-9) also appropriately disclose the anticipated effects of habitat restoration in  
36 Alternative 4.

37 The following impacts are those presented under Alternative 1A that are anticipated to be identical  
38 for Alternative 4.

### 39 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

### 40 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta** 41 **Smelt**

1 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

2 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
3 on delta smelt are the same for Alternative 4, as those described under Alternative 1A (Impacts  
4 AQUA 7-through AQUA-9). Despite the anticipated improvements in habitat and habitat functions in  
5 the Delta from tidal habitat restoration activities, habitat quality for delta smelt is expected to  
6 decline by the LLT primarily because of climate change (Cloern et al. 2011; Brown et al. 2013).  
7 However, it is concluded that overall, the effect of landscape restoration activities in Alternative 4  
8 relative to NAA is expected to provide a net benefit for delta smelt, which spend their entire lives in  
9 the Plan Area. The ultimate performance of habitat restoration is expected to interact with river and  
10 Delta outflows such that the benefits of habitat restoration would be greatest in H4 and lowest in  
11 H1. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium,  
12 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt  
13 are uncertain.

14 **CEQA Conclusion:** All three of the impact mechanisms listed above would be beneficial or less than  
15 significant, and no mitigation is required.

16 **Other Conservation Measures (CM12–CM19 and CM21)**

17 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
18 differences in other conservation-related fish effects are anticipated in the affected environment  
19 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of other  
20 conservation measures described for delta smelt under Alternative 1A (Impacts AQUA-10 through  
21 AQUA-18) also appropriately characterize effects under Alternative 4.

22 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

23 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

24 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

25 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

26 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

27 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

28 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

29 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

30 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

31 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**  
32 **(CM21)**

33 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms  
34 on delta smelt are the same as those described under Alternative 1A (Impacts AQUA-10 through  
35 AQUA-18). The effects range from no effect, to not adverse, to beneficial.

1 **CEQA Conclusion:** The effects of the nine impact mechanisms listed above range from no impact, to  
2 less than significant, to beneficial, and no mitigation is required.

### 3 **Longfin Smelt**

#### 4 **Construction and Maintenance of CM1**

##### 5 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

6 The potential effects of construction of the water conveyance facilities on longfin smelt would be  
7 similar to those described for Alternative 1A (Impact AQUA-19) except that Alternative 4 would  
8 include three intakes compared to five intakes under Alternative 1A, so the effects would be  
9 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing  
10 shoreline habitat into intake facility structures and would require 17.1 acres of dredge and channel  
11 reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and would  
12 require 27.3 acres of dredging). Alternative 4 would use five barge locations rather than six as under  
13 Alternative 1A so those effects would also be proportionally less.

14 Additionally, construction and excavation at Clifton Court Forebay would be done in the dry via  
15 installation of cofferdams for isolation and dewatering of work areas. Implementation of Appendix  
16 3B, *Environmental Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage*  
17 *Plan*, would minimize adverse effects as described for Alternative 1A. Mitigation measures would  
18 also be available to avoid and minimize potential effects.

19 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-19, the effect would not be adverse for  
20 longfin smelt.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-19, the impact of the construction of  
22 water conveyance facilities on longfin smelt would not be significant except for construction noise  
23 associated with pile driving. Potential pile driving impacts under Alternative 4 would be less than  
24 Alternative 1A because only three intakes would be constructed rather than five. Implementation of  
25 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
26 less than significant.

##### 27 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 28 **of Pile Driving and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
30 Alternative 1A.

##### 31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
34 Alternative 1A.

##### 35 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

36 **NEPA Effects:** The potential effects of water conveyance facilities maintenance under Alternative 4  
37 would be the similar to those described for Alternative 1A, Impact AQUA-20, except that only three

1 intakes would need to be maintained under Alternative 4 instead of the five under Alternative 1A. As  
2 concluded in Alternative 1A, Impact AQUA-20, the impact would not be adverse for longfin smelt.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-20, the impact of the maintenance  
4 of water conveyance facilities on longfin smelt would not be significant and no mitigation is  
5 required.

6 **Water Operations of CM1**

7 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

8 **Water Exports from SWP/CVP South Delta Facilities**

9 For larval longfin smelt, entrainment risk was simulated using particle tracking modeling for wetter  
10 and drier starting distributions. Average particle entrainment by the south Delta facilities was 1.0–  
11 1.3% under Scenario H3, which does not include enhanced spring outflow, compared to 1.4–1.8%  
12 under NAA. Larval entrainment under Scenario H1 would be similar to Scenario H3 because of  
13 similar spring outflow and south Delta operations. Under Scenarios H2 and H4 for Alternative 4,  
14 which include enhanced spring outflow, larval longfin smelt entrainment would be lower than NAA  
15 because of the enhanced spring outflow criteria that results in a further reduction in south Delta  
16 exports.

17 **Table 11-4-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**  
18 **Entrained by the South Delta Facilities under Alternative 4 (Scenario H3) and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A4_LL	A4_LL vs. EXISTING CONDITIONS	A4_LL vs. NAA
Wetter	1.7	1.4	1.0	-0.69 (-41%)	-0.45 (-31%)
Drier	2.1	1.8	1.3	-0.83 (-39%)	-0.50 (-28%)

Note: 60-day DSM2-PTM simulation of wetter and drier starting distributions. Negative values indicate lower entrainment under the alternative compared to the baseline scenario.

19  
20 For juveniles and adults, entrainment at the south Delta facilities (entrainment index based on the  
21 salvage-density method, averaged across all water year types) under the Scenario H3 would be 42%  
22 lower for juveniles and 52% lower for adults compared to baseline conditions (Table 11-4-5).  
23 Scenarios H2 and H4 would result in even greater reductions in entrainment, due to higher spring  
24 outflows and the associated reduction in south Delta exports. Under all Alternative 4 scenarios, the  
25 predicted adult and juvenile entrainment decreases in all five water year types. Estimated  
26 entrainment under Scenario H1 would be similar to Scenario H3.

1 **Table 11-4-5. Longfin Smelt Entrainment Index at the SWP and CVP Salvage Facilities—Differences**  
2 **(Absolute and Percentage) between Model Scenarios for Alternative 4 (Scenario H3)**

Life Stage	Water Year Types	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
Juvenile (March–June)	Wet	-34,213 (-54%)	-39,655 (-57%)
	Above Normal	-1,054 (-23%)	-1,343 (-28%)
	Below Normal	-571 (-19%)	-779 (-24%)
	Dry	-65,111 (-12%)	-123,418 (-21%)
	Critical	-199,486 (-35%)	-125,616 (-25%)
	All Years	-97,872 (-37%)	-122,883 (-42%)
Adult (December–March)	Wet	-67 (-52%)	-71 (-53%)
	Above Normal	-302 (-46%)	-342 (-50%)
	Below Normal	-728 (-38%)	-650 (-35%)
	Dry	-364 (-30%)	-299 (-26%)
	Critical	-7,981 (-33%)	-5,847 (-26%)
	All Years	-1,885 (-52%)	-1,849 (-52%)

3

4 ***Water Exports from SWP/CVP North Delta Intake Facilities***

5 As described under Alternative 1A for Impact AQUA-22, longfin smelt are not known to spawn in the  
6 reach of the Sacramento River where the north Delta diversions will be built. Therefore,  
7 entrainment of longfin smelt at the proposed north Delta intakes would be extremely low because  
8 this species is only expected to occur occasionally in very low numbers this far upstream on the  
9 Sacramento River.

10 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

11 Particle tracking modeling was used to simulate larval longfin smelt entrainment to the NBA under  
12 Scenario H3. In general, average percent particle entrainment at the NBA under both NAA and  
13 Scenario H3 was about 0.1% for the wetter starting distribution, and was just under 0.2% for  
14 Alternative 4 and 0.14% for NAA under the drier starting distribution (Table 11-4-6). Entrainment  
15 of larval longfin smelt under Alternative 4 for all scenarios is expected to be low and similar to NAA.  
16 Note that the PTM modeling results do not account for the provision of an alternative NBA intake on  
17 the Sacramento River upstream of longfin smelt likely areas of occurrence, which potentially would  
18 reduce the number of longfin smelt larvae that otherwise would be entrained at the Barker Slough  
19 intake to the NBA.

1 **Table 11-4-6. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**  
 2 **Entrained by the North Bay Aqueduct under Alternative 4 (Scenario H3) and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A4_LLТ	A4_LLТ vs. EXISTING CONDITIONS	A4_LLТ vs. NAA
Wetter	0.10	0.09	0.10	0.00 (-3%)	0.01 (10%)
Drier	0.18	0.14	0.19	0.01 (7%)	0.04 (31%)

Note: Values reported are averages of 60-day DSM2-PTM simulation of wetter and drier starting distributions, based on 27 simulated months. Negative values indicate lower entrainment under the alternative compared to the baseline scenario.

3

4 **Predation Associated with Entrainment**

5 Pre-screen predation losses of longfin smelt at the SWP/CVP south Delta water export facilities are  
 6 believed to be high and proportional to entrainment. It is assumed that pre-screen predation losses  
 7 of longfin smelt would be similar to delta smelt based on their similar size, shape, and pelagic  
 8 nature. Predation losses of both juvenile and adult longfin smelt under Alternative 4 would be no  
 9 greater than baseline and may be lower, given the much lower entrainment losses at the south Delta  
 10 facilities (37–42% lower for juveniles and 52–53% lower for adults) compared to NAA (Table 11-4-  
 11 5). Predation loss at the proposed north Delta intakes would be unlikely because longfin smelt do  
 12 not generally occur that far upstream on the Sacramento River. Under the range of flow operating  
 13 scenarios under Alternative 4, entrainment-related predation loss would be reduced relative to  
 14 NAA, with the greatest decreases in entrainment occurring under Scenario H4.

15 **NEPA Effects:** To summarize, predation of juvenile and adult longfin smelt, as a function of  
 16 entrainment at the SWP/CVP south Delta facilities, would be reduced substantially under all flow  
 17 operating scenario for Alternative 4 compared to NAA across all water years (Table 11-4-5).  
 18 Predation loss of longfin smelt at the proposed north Delta intakes would be unlikely since longfin  
 19 smelt are not expected to occur in that area of the Sacramento River. Longfin smelt entrainment to  
 20 the NBA, and associated predation, would be unchanged compared to NAA. The predation risk  
 21 associated with the NPВ structures would be low, the same as described for Alternative 1A. In  
 22 conclusion, Alternative 4 would not have an adverse effect on entrainment-related predation and  
 23 would likely provide a benefit to the species because of substantial reductions in juvenile and adult  
 24 entrainment at the south Delta facilities.

25 **CEQA Conclusion:** Entrainment of all life stages of longfin smelt at the south Delta facilities would be  
 26 reduced under Alternative 4 compared to Existing Conditions. Particle entrainment, representing  
 27 larval longfin smelt, was lower under Alternative 4 for both drier and wetter starting distributions  
 28 (refer to *BDCP Appendix 5.B* for further details). Entrainment loss would be substantially lower for  
 29 both juvenile (37% less) and adult longfin smelt (52% less) (Table 11-4-5). Entrainment to the  
 30 north Delta intakes would be unlikely because longfin smelt are not expected to occur in the vicinity  
 31 of the intakes. Larval entrainment to the NBA, as indicated by particle tracking, would be minimal  
 32 under both wetter (0.1%) and drier (0.2%) starting distributions, and at levels similar to the  
 33 Existing Conditions. In conclusion, Alternative 4 would provide a benefit to the species because of  
 34 the substantial reductions in south Delta entrainment, and therefore no mitigation would be  
 35 required.

1 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**  
2 **Habitat for Longfin Smelt**

3 Adult longfin smelt inhabit primarily brackish water and marine areas in San Pablo and San  
4 Francisco Bays and nearshore coastal marine waters. Prespawning adult longfin smelt use the Delta  
5 for staging and spawning. The planktonic larvae are transported downstream after hatching; within  
6 the Plan Area, the early juvenile life stages rear in the low-salinity areas of the West Delta and  
7 Suisun Bay subregions. Juvenile and adult longfin smelt occupying the Plan Area during fall through  
8 spring migrate westward into San Francisco Bay during the summer.

9 Longfin smelt spawn in the late winter and early spring months when water temperatures in the  
10 lower rivers and Delta are seasonally cool. Longfin smelt spawn adhesive eggs that are thought to be  
11 deposited on sand and gravel and possibly other hard substrates. Spawning occurs in the lower  
12 reaches of the Sacramento River in the vicinity of Cache Slough and Rio Vista, although some  
13 spawning occurs in the lower San Joaquin River based on presence of early larval and adult longfin  
14 smelt in CDFW larval trawl samples (California Department of Fish and Game 2009b). Spawning also  
15 occurs in Suisun Marsh and the Napa River.

16 Immediately after hatching from the incubating eggs, longfin smelt larvae are planktonic and drift  
17 passively with water flows; older larvae use a variety of behaviors to help retain themselves in  
18 favorable habitats (Bennett et al. 2002). Larvae are typically present in the Delta during the late  
19 winter and early spring months. Juvenile longfin smelt rear in the spring (approximately March to  
20 June) in the Suisun Bay and the West Delta subregions before migrating downstream of the Plan  
21 Area into San Pablo and San Francisco Bays and nearshore coastal marine waters, where they  
22 continue to rear for a year or more. Larval and early juvenile longfin smelt could be affected by  
23 covered activities when they are present in the Plan Area during the winter and spring months.

24 Longfin smelt rear in the Plan Area principally during spring and the abundance of longfin smelt in  
25 the Fall Midwater Trawl (FMWT) has been correlated to outflow (expressed as the location of X2) in  
26 the preceding winter and spring months (January–June), when spawning and rearing are occurring  
27 (Kimmerer 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010;  
28 Thomson et al. 2010). Based on Kimmerer et al. (2009), reduced outflow in January through June,  
29 compared to the NAA, has the potential to reduce longfin smelt abundance. The X2–longfin smelt  
30 abundance relationship provided by Kimmerer et al. (2009) was used to evaluate the effects of the  
31 alternatives on longfin smelt, following the historical observation that lower X2 (farther  
32 downstream) would contribute to increased recruitment. Relationships between December through  
33 May X2 position and log longfin smelt abundance developed by Kimmerer et al. (2009) were used to  
34 determine how the changes in winter-spring X2 position described above might influence longfin  
35 smelt abundance the following fall.

1 **Table 11-4-7. Differences in Mean Monthly Delta Outflow (cfs) between NAA and Alternative 4**  
2 **Scenarios H1, H2, H3, and H4, by Water Year Type, for Winter-Spring (December–June)**

Month	Water-Year Type	NAA vs. H1	NAA vs. H2	NAA vs. H3	NAA vs. H4
January	Wet	-423 (-0.4%)	-833 (-0.9%)	-3,978 (-4.2%)	-2,778 (-2.9%)
	Above Normal	-468 (-0.9%)	-533 (-1%)	-2,949 (-5.8%)	-3,029 (-5.9%)
	Below Normal	-68 (-0.3%)	610 (2.7%)	-676 (-3%)	-177 (-0.8%)
	Dry	901 (6.1%)	1,674 (11.4%)	649 (4.4%)	332 (2.3%)
	Critical	852 (6.7%)	892 (7.1%)	824 (6.5%)	-388 (-3.1%)
	All	108 (0.2%)	260 (0.6%)	-1,545 (-3.3%)	-1,338 (-2.9%)
February	Wet	97 (0.1%)	90 (0.1%)	-809 (-0.8%)	-1,222 (-1.1%)
	Above Normal	66 (0.1%)	919 (1.4%)	-1,817 (-2.8%)	-1,193 (-1.8%)
	Below Normal	-911 (-2.5%)	156 (0.4%)	-2,017 (-5.6%)	-1,026 (-2.8%)
	Dry	-1,313 (-6.1%)	-1,297 (-6%)	-1,218 (-5.7%)	-1,111 (-5.2%)
	Critical	-205 (-1.6%)	-212 (-1.7%)	-270 (-2.1%)	20 (0.2%)
	All	-433 (-0.8%)	-126 (-0.2%)	-1,174 (-2.1%)	-978 (-1.7%)
March	Wet	-512 (-0.6%)	1,826 (2.2%)	-1,504 (-1.8%)	944 (1.1%)
	Above Normal	-213 (-0.4%)	472 (0.8%)	-1,507 (-2.7%)	-613 (-1.1%)
	Below Normal	-2,167 (-9.6%)	2,283 (10.2%)	-2,846 (-12.7%)	1,447 (6.4%)
	Dry	-2,440 (-12.2%)	-693 (-3.5%)	-2,523 (-12.6%)	-737 (-3.7%)
	Critical	-332 (-2.7%)	-111 (-0.9%)	-353 (-2.9%)	-258 (-2.1%)
	All	-1,148 (-2.5%)	870 (1.9%)	-1,789 (-4%)	257 (0.6%)
April	Wet	-5,353 (-9.81%)	-138 (-0.3%)	-5,586 (-10.2%)	-438 (-0.8%)
	Above Normal	-5,242 (-17.1%)	1,976 (6.5%)	-5,173 (-16.9%)	2,154 (7%)
	Below Normal	-2,098 (-10.2%)	4,079 (19.8%)	-2,229 (-10.8%)	3,743 (18.1%)
	Dry	-707 (-5.3%)	404 (3%)	-798 (-6%)	409 (3%)
	Critical	-344 (-3.7%)	-344 (-3.7%)	-406 (-4.4%)	-264 (-2.8%)
	All	-3,028 (-10.2%)	980 (3.3%)	-3,143 (-10.6%)	867 (2.9%)
May	Wet	-3,574 (-10.9%)	220 (0.7%)	-3,608 (-11%)	274 (0.8%)
	Above Normal	-2,417 (-11.1%)	731 (3.4%)	-2,343 (-10.8%)	728 (3.4%)
	Below Normal	110 (0.8%)	1,908 (14%)	257 (1.9%)	1,625 (12%)
	Dry	628 (6.1%)	663 (6.4%)	660 (6.4%)	580 (5.6%)
	Critical	38 (0.6%)	142 (2.3%)	-15 (-0.2%)	128 (2%)
	All	-1,325 (-6.9%)	669 (3.5%)	-1,300 (-6.8%)	617 (3.2%)
June	Wet	139 (0.9%)	-87 (-0.6%)	101 (0.6%)	-240 (-1.5%)
	Above Normal	320 (3%)	-233 (-2.2%)	378 (3.5%)	-168 (-1.6%)
	Below Normal	942 (10.5%)	982 (11%)	710 (7.9%)	984 (11%)
	Dry	207 (2.7%)	67 (0.9%)	127 (1.7%)	83 (1.1%)
	Critical	-276 (-4.9%)	-297 (-5.3%)	-312 (-5.5%)	-298 (-5.3%)
	All	257 (2.4%)	77 (0.7%)	191 (1.8%)	42 (0.4%)
December	Wet	1,737 (3.8%)	3,380 (7.5%)	-1,178 (-2.6%)	-261 (-0.6%)
	Above Normal	817 (4.3%)	-622 (-3.3%)	10 (0.1%)	-693 (-3.6%)
	Below Normal	923 (7.5%)	612 (5%)	-26 (-0.2%)	-241 (-2%)
	Dry	972 (11%)	692 (7.8%)	682 (7.7%)	678 (7.7%)
	Critical	288 (4.4%)	124 (1.9%)	-130 (-2%)	-572 (-8.7%)
	All	1,083 (4.9%)	1,255 (5.7%)	-246 (-1.1%)	-160 (-0.7%)

3

1 Ultimately, initial Alternative 4 water operations will be determined through the BDCP decision tree  
2 process to determine the necessary spring Delta outflow. Under Scenarios H1 and H3, which do not  
3 include enhanced spring outflow, modeled average Delta spring outflow is often lower than the NAA.  
4 The spring outflows in H2 and H4, which include the enhanced spring outflow, were greater than  
5 NAA in a number of years, as illustrated by differences in water-year-type average Delta outflow  
6 (See Table 11-4-7 above). As such, based on Kimmerer et al. 2009, the longfin smelt abundance for  
7 H1 and H3 ranged from a reduction of 32 to 37% compared to Existing Conditions, to a reduction of  
8 3% to an increase of 3% compared to the NAA. For H2 and H4, which include enhanced spring  
9 outflow and climate change effects, the predicted longfin smelt abundance ranged from a reduction  
10 of 26% to 30% compared to Existing Conditions to an increase of 12% to 16% when compared to  
11 the NAA, based on the X2-abundance equation in Kimmerer et al. (2009).

12 **NEPA Effects:** Through the term of the permit, BDCP water operations will be subject to adjustment  
13 via adaptive management, beginning with the decision tree process in the years prior to CM1  
14 operations. Recognizing the uncertainties of habitat restoration and disagreement regarding the  
15 magnitudes of spring outflow augmentation necessary to support the conservation of longfin smelt,  
16 the Decision Tree phase of adaptive management is designed to allow for further evaluation of this,  
17 and other species' spring outflow needs, concurrent with early evaluation of the level of benefits of  
18 BDCP habitat restoration for longfin smelt. The decision tree process will inform a decision made at  
19 the time CM1 operations begin regarding the parameters of water operations. That decision will, on  
20 the basis of what has been learned about the effects of outflow and habitat restoration, identify CM1  
21 operations that are expected to meet the longfin smelt population growth objective. Those  
22 operations will ensure the impacts of water operations on rearing habitat for longfin smelt are not  
23 adverse and support a contribution to recovery of this species. Following this decision, the Adaptive  
24 Management Program will continue to evaluate the effects of water operations and habitat  
25 restoration on the longfin smelt population, including making adjustments as appropriate to  
26 improve water supply reliability.

1 **Table 11-4-8. Estimated Differences Between Alternative 4 (Scenario H3) and Baseline for Longfin**  
 2 **Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl Based on the X2-Relative**  
 3 **Abundance Regression of Kimmerer et al. (2009)**

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
<b>Scenario H3</b>				
All	-2,959 (-33%)	77 (1%)	-11,658 (-38%)	544 (3%)
Wet	-6,423 (-34%)	614 (5%)	-27,026 (-39%)	2,856 (7%)
Above Normal	-3,264 (-32%)	-267 (-4%)	-12,018 (-37%)	-881 (-4%)
Below Normal	-1,629 (-36%)	-291 (-9%)	-5,107 (-42%)	-903 (-11%)
Dry	-619 (-27%)	-106 (-6%)	-1,747 (-31%)	-295 (-7%)
Critical	-208 (-20%)	-38 (-4%)	-511 (-24%)	-93 (-5%)
<b>Scenario H1 (Low Outflow)</b>				
All	-2,879 (-32%)	157 (3%)	-11,367 (-37%)	836 (5%)
Wet	-6,298 (-33%)	739 (6%)	-26,515 (-38%)	3,367 (8%)
Above Normal	-3,069 (-31%)	-72 (-1%)	-11,361 (-35%)	-224 (-1%)
Below Normal	-1,558 (-35%)	-220 (-7%)	-4,907 (-40%)	-702 (-9%)
Dry	-626 (-27%)	-113 (-6%)	-1,764 (-32%)	-313 (-8%)
Critical	-199 (-19%)	-29 (-3%)	-490 (-23%)	-71 (-4%)
<b>Scenario H4 (High Outflow)</b>				
All	-2,308 (-26%)	727 (12%)	-9,338 (-31%)	2,864 (16%)
Wet	-5,359 (-28%)	1,678 (14%)	-23,092 (-33%)	6,790 (17%)
Above Normal	-2,060 (-20%)	936 (13%)	-7,606 (-24%)	3,531 (17%)
Below Normal	-946 (-21%)	391 (12%)	-2,958 (-24%)	1,246 (16%)
Dry	-519 (-22%)	-6 (0%)	-1,453 (-26%)	-2 (0%)
Critical	-221 (-21%)	-51 (-6%)	-539 (-25%)	-120 (-7%)
Shading indicates relative abundance under Alt4 decrease of 10% or greater.				

4

5 **CEQA Conclusion:** Under Alternative 4, average Delta outflow would be slightly greater than under  
 6 Existing Conditions during January and February (Table 11-4-9). Under Scenarios H1 and H3,  
 7 monthly Delta outflow is reduced in March to June compared to Existing Conditions, with variation  
 8 among water year types. Under Scenarios H2 and H4, average Delta outflows would be similar to  
 9 Existing Conditions from January to April, but on average 12% lower in May and 17% lower in June.

1 **Table 11-4-9. Differences in Mean Monthly Delta Outflow (cfs) between Existing Conditions and**  
 2 **Alternative 4 Scenarios H1, H2, H3, and H4, by Water Year Type, for Winter-Spring (December–June)**

Month	Water-Year Type	EXISTING CONDITIONS vs. H1	EXISTING CONDITIONS vs. H2	EXISTING CONDITIONS vs. H3	EXISTING CONDITIONS vs. H4
January	Wet	8,297 (9.7%)	7,887 (9.2%)	4,741 (5.5%)	5,942 (6.9%)
	Above Normal	1,185 (2.4%)	1,119 (2.3%)	-1,297 (-2.6%)	-1,377 (-2.8%)
	Below Normal	-736 (-3.2%)	-57 (-0.2%)	-1,343 (-5.8%)	-844 (-3.7%)
	Dry	898 (6.1%)	1,671 (11.3%)	646 (4.4%)	329 (2.2%)
	Critical	2,160 (19%)	2,200 (19.4%)	2,132 (18.8%)	920 (8.1%)
	All	3,192 (7.4%)	3,343 (7.7%)	1,538 (3.6%)	1,745 (4%)
February	Wet	10,347 (10.7%)	10,340 (10.7%)	9,441 (9.8%)	9,028 (9.3%)
	Above Normal	3,618 (5.8%)	4,471 (7.2%)	1,735 (2.8%)	2,358 (3.8%)
	Below Normal	-1,593 (-4.3%)	-526 (-1.4%)	-2,699 (-7.3%)	-1,708 (-4.6%)
	Dry	-767 (-3.7%)	-751 (-3.6%)	-673 (-3.2%)	-565 (-2.7%)
	Critical	-398 (-3.1%)	-405 (-3.1%)	-463 (-3.6%)	-173 (-1.3%)
	All	3,312 (6.3%)	3,619 (6.9%)	2,571 (4.9%)	2,767 (5.3%)
March	Wet	5,003 (6.3%)	7,342 (9.3%)	4,012 (5.1%)	6,459 (8.2%)
	Above Normal	2,353 (4.3%)	3,039 (5.6%)	1,060 (2%)	1,953 (3.6%)
	Below Normal	-3,728 (-15.5%)	722 (3%)	-4,408 (-18.3%)	-114 (-0.5%)
	Dry	-2,334 (-11.7%)	-588 (-3%)	-2,418 (-12.2%)	-632 (-3.2%)
	Critical	-28 (-0.2%)	193 (1.6%)	-49 (-0.4%)	45 (0.4%)
	All	778 (1.8%)	2,795 (6.5%)	137 (0.3%)	2,182 (5.1%)
April	Wet	-5,185 (-9.5%)	30 (0.1%)	-5,418 (-10%)	-270 (-0.5%)
	Above Normal	-6,641 (-20.8%)	577 (1.8%)	-6,572 (-20.6%)	754 (2.4%)
	Below Normal	-3,385 (-15.4%)	2,793 (12.7%)	-3,516 (-16%)	2,457 (11.2%)
	Dry	-1,435 (-10.2%)	-325 (-2.3%)	-1,527 (-10.8%)	-319 (-2.3%)
	Critical	-104 (-1.1%)	-104 (-1.1%)	-166 (-1.8%)	-24 (-0.3%)
	All	-3,524 (-11.7%)	484 (1.6%)	-3,639 (-12.1%)	371 (1.2%)
May	Wet	-11,733 (-28.6%)	-7,940 (-19.3%)	-11,767 (-28.7%)	-7,885 (-19.2%)
	Above Normal	-4,908 (-20.3%)	-1,760 (-7.3%)	-4,833 (-20%)	-1,762 (-7.3%)
	Below Normal	-2,593 (-15.9%)	-795 (-4.9%)	-2,446 (-15%)	-1,078 (-6.6%)
	Dry	515 (4.9%)	550 (5.2%)	547 (5.2%)	468 (4.5%)
	Critical	324 (5.4%)	428 (7.1%)	271 (4.5%)	415 (6.9%)
	All	-4,721 (-21%)	-2,727 (-12.1%)	-4,696 (-20.9%)	-2,779 (-12.3%)
June	Wet	-7,672 (-32.7%)	-7,898 (-33.7%)	-7,710 (-32.9%)	-8,051 (-34.3%)
	Above Normal	-805 (-6.8%)	-1,358 (-11.5%)	-747 (-6.3%)	-1,293 (-11%)
	Below Normal	1,881 (23.5%)	1,921 (24%)	1,649 (20.6%)	1,923 (24%)
	Dry	1,261 (19%)	1,121 (16.9%)	1,181 (17.8%)	1,136 (17.1%)
	Critical	34 (0.6%)	13 (0.2%)	-2 (0%)	11 (0.2%)
	All	-1,948 (-15.3%)	-2,127 (-16.7%)	-2,014 (-15.8%)	-2,162 (-16.9%)
December	Wet	-1,258 (-2.6%)	386 (0.8%)	-4,172 (-8.7%)	-3,255 (-6.8%)
	Above Normal	1,921 (10.7%)	482 (2.7%)	1,115 (6.2%)	412 (2.3%)
	Below Normal	1,204 (10.1%)	893 (7.5%)	255 (2.1%)	40 (0.3%)
	Dry	916 (10.3%)	636 (7.2%)	626 (7%)	622 (7%)
	Critical	1,317 (23.8%)	1,154 (20.9%)	899 (16.3%)	458 (8.3%)
	All	482 (2.1%)	654 (2.9%)	-847 (-3.7%)	-762 (-3.4%)

1 Average relative abundance of longfin smelt, as estimated by the Kimmerer et al. 2009 method, is  
2 32% to 38% lower under Scenarios H1 and H3 compared to Existing Conditions (Table 11-4-8). For  
3 H2 and H4, which include enhanced spring outflow, the longfin smelt abundance is 26% to 31%  
4 lower compared to Existing Conditions, based on Kimmerer et al. 2009.

5 Contrary to the NEPA conclusion set forth above, these results indicate that the difference between  
6 Existing Conditions and Alternative 4 could be significant because the alternative could substantially  
7 reduce relative abundance based on Kimmerer 2009. However, this interpretation of the biological  
8 modeling results is likely attributable to different modeling assumptions for four factors: sea level  
9 rise, climate change, future water demands, and implementation of the alternative. As discussed  
10 above (Section 11.3.3), because of differences between the CEQA and NEPA baselines, it is  
11 sometimes possible for CEQA and NEPA significance conclusions to vary between one another under  
12 the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the  
13 NOP was prepared. Both the action alternative and the NEPA baseline (NAA) models anticipated  
14 future conditions that would occur in 2060 (LLT implementation period), including the projected  
15 effects of climate change (precipitation patterns), sea level rise and future water demands, as well as  
16 implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because  
17 the action alternative modeling does not partition the effects of implementation of the alternative  
18 from the effects of sea level rise, climate change and future water demands, the comparison to  
19 Existing Conditions may not offer a clear understanding of the impact of the alternative on the  
20 environment. This suggests that the NEPA analysis, which compares results between the alternative  
21 and NAA, is a better approach because it isolates the effect of the alternative from those of sea level  
22 rise, climate change, and future water demands.

23 When compared to NAA and informed by the NEPA analysis, above, the average longfin smelt  
24 abundance, based on Kimmerer et al. (2009), increased 1% to 5% for H1 and H3, and increased 12%  
25 to 16% for H2 and H4, which include enhanced spring outflow (Table 11-4-8). These results  
26 represent the increment of change attributable to the alternative, demonstrating the similarities in  
27 modeled longfin smelt recruitment under Alternative 4 and the NAA, and addressing the limitations  
28 of the comparison the CEQA baseline (Existing Conditions). Furthermore, the decision tree process,  
29 which is part of the Adaptive Management and Monitoring Program, is designed to allow for an  
30 evaluation of the needed volume of spring outflow and to inform a decision regarding starting  
31 operations. This will help the BDCP to meet the longfin smelt population growth and abundance  
32 objectives, and will ensure the impacts of water operations on spawning, egg incubation and rearing  
33 habitat for longfin smelt are less than significant. After initial starting operations, the Adaptive  
34 Management Program will continue to evaluate water operations and make adjustments as  
35 necessary to protect longfin smelt abundances and ensure the impacts of water operations on  
36 spawning, egg incubation and rearing habitat for longfin smelt are less than significant. Therefore,  
37 this impact is found to be less than significant and no mitigation is required. In addition, CM4 could  
38 also improve the quality of spawning and rearing habitat for longfin smelt, by increasing suitable  
39 habitat area and food production in the Delta, although there is some uncertainty of the outcome  
40 related to habitat restoration.

#### 41 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

42 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on rearing habitat  
43 for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on Spawning, Egg  
44 Incubation, and Rearing Habitat for Longfin Smelt.

1 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

2 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on migration  
3 conditions for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on  
4 Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.

5 **Restoration Measures (CM2, CM4–CM7, and CM10)**

6 Alternative 4 has the same restoration measures as Alternative 1A. Because no substantial  
7 differences in restoration-related effects on fish are anticipated anywhere in the affected  
8 environment under Alternative 4 compared to those described in detail for Alternative 1A, the  
9 effects of restoration measures on longfin smelt described under Alternative 1A (Impacts AQUA-25  
10 through AQUA-27) also appropriately characterize effects under Alternative 4.

11 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

12 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

13 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**  
14 **Smelt**

15 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

16 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
17 on longfin smelt are the same, as those described under Alternative 1A (Impacts AQUA-25 through  
18 AQUA-27). The effects would not be adverse, and would generally be beneficial. Specifically for  
19 AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia  
20 and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

21 **CEQA Conclusion:** All three of the impact mechanisms listed above would be at least slightly  
22 beneficial, or less than significant, and no mitigation is required for the reasons identified for  
23 Alternative 1A.

24 **Other Conservation Measures (CM12–CM19 and CM21)**

25 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
26 differences in other conservation-related effects on fish are anticipated anywhere in the affected  
27 environment under Alternative 4 compared to those described in detail for Alternative 1A, the  
28 effects of other conservation measures on longfin smelt described under Alternative 1A (Impacts  
29 AQUA-28 through AQUA-36) also appropriately characterize effects under Alternative 4.

30 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

31 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

32 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**  
33 **(CM13)**

34 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

35 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

1 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

2 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

3 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

4 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

5 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**  
6 **(CM21)**

7 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms  
8 on longfin smelt are the same as those described under Alternative 1A (Impacts AQUA-28 through  
9 AQUA-36). The effects range from no effect, to not adverse, to beneficial.

10 *CEQA Conclusion:* The effects of the nine impact mechanisms listed above range from no impact, to  
11 less than significant, to beneficial, and no mitigation is required.

12 **Winter-Run Chinook Salmon**

13 **Construction and Maintenance of CM1**

14 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
15 **(Winter-Run ESU)**

16 The potential effects of construction of the water conveyance facilities on winter-run Chinook  
17 salmon would be the same as those described for Alternative 1A (Impact AQUA-37) except that  
18 Alternative 4 would include three intakes instead of five, so the effects would be proportionally less  
19 under this alternative. This would convert about 6,360 lineal feet of existing shoreline habitat into  
20 intake facility structures and would require about 17.1 acres of dredge and channel reshaping. In  
21 contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and would require 27.3 acres  
22 of dredging. Alternative 4 would use five barge locations rather than six as under Alternative 1A so  
23 those effects would also be proportionally less. Additionally, construction and excavation at Clifton  
24 Court Forebay would be done in the dry via installation of cofferdams for isolation and dewatering  
25 of work areas. Implementation of Appendix 3B, *Environmental Commitments*, including construction  
26 BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize adverse effects as described for  
27 Alternative 1A. Mitigation measures would also be available to avoid and minimize potential effects.

28 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-37, the effect would not be adverse for  
29 Chinook salmon.

30 *CEQA Conclusion:* As described in Alternative 1A (Impact AQUA-37) the impact of construction of  
31 the water conveyance facilities on Chinook salmon would not be significant except for construction  
32 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
33 because only three intakes would be constructed rather than five. Implementation of Mitigation  
34 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
35 significant.

1           **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
2           **of Pile Driving and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
4           Alternative 1A.

5           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
6           **and Other Construction-Related Underwater Noise**

7           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
8           Alternative 1A.

9           **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
10          **(Winter-Run ESU)**

11          **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
12          Alternative 4 would be the same as those described for Alternative 1A (Impact AQUA-38) except  
13          that only three intakes would need to be maintained under Alternative 4 rather than five under  
14          Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the impact would not be adverse  
15          for winter-run Chinook salmon.

16          **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance  
17          of water conveyance facilities on Chinook salmon would be less than significant and no mitigation is  
18          required.

19          **Water Operations of CM1**

20          **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**  
21          **Run ESU)**

22          ***Water Exports from SWP/CVP South Delta Facilities***

23          The proportion of juvenile winter-run Chinook salmon subject to entrainment is low under Existing  
24          Conditions and NAA (annual index of abundance average 1.4%) and Alternative 4 would further  
25          reduce entrainment of juvenile winter-run Chinook salmon at the south Delta facilities. For example,  
26          Scenario H3 would reduce the proportion of juvenile winter-run Chinook entrained in the south  
27          Delta (average of 0.6%). As such, average entrainment under Scenario H3 would be reduced by 52%  
28          (~3,500 fish: Table 11-4-10) across all water years compared to NAA. Entrainment would be  
29          substantially reduced in wet and above normal water year types (60–70% less than NAA) and would  
30          be moderately reduced in below normal, dry, and critical water year types (18–33% less than NAA).

31          Scenarios H2 and H4 is expected to further reduce entrainment of winter-run salmon because south  
32          Delta exports during the spring would be less relative to the Scenario H3. Entrainment losses under  
33          Scenario H1 are expected to be similar to Scenario H3.

1 **Table 11-4-10. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index at the SWP and**  
 2 **CVP Salvage Facilities—Differences between Model Scenarios for Alternative 4 (Scenario H3)**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-7,816 (-69%)	-8,237 (-70%)
Above Normal	-3,919 (-59%)	-4,043 (-60%)
Below Normal	-2,666 (-37%)	-2,241 (-33%)
Dry	-1,116 (-29%)	-809 (-23%)
Critical	-343 (-27%)	-205 (-18%)
All Years	-3,584 (-53%)	-3,524 (-52%)

Note: Estimated annual number of fish lost, based on normalized data.

3

4 ***Water Exports from SWP/CVP North Delta Intake Facilities***

5 The effect of Alternative 4 on entrainment and impingement at the north Delta intakes would be the  
 6 same as described for Alternative 1A (Impact AQUA-39), but the degree would be less because  
 7 Alternative 4 would have fewer intakes. State-of-the-art fish screens operated with an adaptive  
 8 management plan would be expected to eliminate entrainment risk for juvenile winter-run Chinook  
 9 salmon.

10 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

11 The effect would be the same as described for Alternative 1A (Impact AQUA-39). Entrainment and  
 12 impingement effects would be minimal because intakes on the Sacramento River would have state-  
 13 of-the-art screens installed.

14 ***Predation Associated with Entrainment***

15 Entrainment-related predation loss of winter-run Chinook salmon at the south Delta facilities under  
 16 this alternative would be no greater than loss under NAA and may be lower than loss under NAA  
 17 due to a decrease in entrainment loss. Entrainment-related predation losses at the south Delta  
 18 under Scenario H1 are expected to be similar to Scenario H3, and decreased further under Scenarios  
 19 H2 and H4 as spring outflow is increased and south Delta exports are decreased.

20 Predation at the north Delta would be increased due to the installation of the proposed SWP/CVP  
 21 North Delta intake facilities on the Sacramento River. Bioenergetics modeling with a median  
 22 predator density predicts increased predation loss of about 4,300 juveniles, or 0.16% of the winter-  
 23 run Chinook salmon juvenile index of abundance under Alternative 4 (Table 11-4-11).

1 **Table 11-4-11. Winter-Run Chinook Salmon Predation Loss at the Proposed North Delta Diversion**  
2 **(NDD) Intakes (Three Intakes for Alternative 4)**

Striped Bass at NDD (Three Intakes)			Winter-Run Chinook Consumed	
Density Assumption	Bass per 1,000 Feet of Intake	Total Number of Bass	Number	Percentage of Annual Juvenile Production
Low	18	86	648	0.02%
Median	119	571	4,283	0.16%
High	219	1,051	7,881	0.30%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

3  
4 **NEPA Effects:** In conclusion, Alternative 4 would reduce overall entrainment losses of juvenile  
5 winter-run Chinook salmon relative to NAA. This effect would not be adverse and would provide a  
6 benefit to the species because of the reductions in entrainment loss and mortality.

7 **CEQA Conclusion:** As described above, entrainment losses of juvenile winter-run Chinook salmon at  
8 the south Delta facilities would decrease under Alternative 4 compared to Existing Conditions  
9 (Table 11-4-10). Overall, impacts of water operations on entrainment of juvenile Chinook salmon  
10 (winter-run ESU) would be less than significant and may be beneficial. No mitigation would be  
11 required.

12 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
13 **Chinook Salmon (Winter-Run ESU)**

14 In general, the effects of Alternative 4 on spawning and egg incubation habitat for winter-run  
15 Chinook salmon relative to the NAA are uncertain.

16 **H3/ESO**

17 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were  
18 examined during the May through September winter-run spawning period (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for  
20 spawning and egg incubation. Flows under H3 would generally be greater (by up to 20%) than flows  
21 under NAA during May and June and similar during July through September. Based on these flow  
22 results, it is expected that H3 would generally provide flow-related benefits to winter-run Chinook  
23 salmon spawning and egg incubation habitat in earlier months and no effects in later months.

24 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the  
25 May through September winter-run spawning and egg incubation period. May Shasta storage under  
26 H3 would be similar (<5% difference) to storage under NAA for all water year types (Table 11-4-  
27 12).

1 **Table 11-4-12. Difference and Percent Difference in May Water Storage Volume (thousand**  
2 **acre-feet) in Shasta Reservoir for Alternative 4 (Scenario H3)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-59 (-1%)	-25 (-1%)
Above Normal	-156 (-3%)	-70 (-2%)
Below Normal	-330 (-8%)	-132 (-3%)
Dry	-550 (-15%)	-106 (-3%)
Critical	-622 (-25%)	-38 (-2%)

3  
4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
5 examined during the May through September winter-run spawning period (Appendix 11D,  
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
8 NAA and H3 in any month or water year type throughout the period at either location.

9 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
10 determined for each month (May through September) and year of the 82-year modeling period  
11 (Table 11-4-13). The combination of number of days and degrees above the 56°F threshold were  
12 further assigned a “level of concern”, as defined in Table 11-4-14. Differences between baselines and  
13 H3 in the highest level of concern across all months and all 82 modeled years are presented in Table  
14 11-4-15. There would be no difference in levels of concern between NAA and H3.

15 **Table 11-4-13. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided**  
16 **by NMFS and Used in the BDCP Effects Analysis**

Location	Period	Maximum Water Temperature (°F)	Purpose
<b>Upper Sacramento River</b>			
Bend Bridge	May-Sep	56	Winter- and spring-run spawning and egg incubation
		63	Green sturgeon spawning and egg incubation
Red Bluff	Oct-Apr	56	Spring-, fall-, and late fall-run spawning and egg incubation
Hamilton City	Mar-Jun	61 (optimal), 68 (lethal)	White sturgeon spawning and egg incubation
<b>Feather River</b>			
Robinson Riffle (RM 61.6)	Sep-Apr	56	Spring-run and steelhead spawning and incubation
	May-Aug	63	Spring-run and steelhead rearing
Gridley Bridge	Oct-Apr	56	Fall- and late fall-run spawning and steelhead rearing
	May-Sep	64	Green sturgeon spawning, incubation, and rearing
<b>American River</b>			
Watt Avenue Bridge	May-Oct	65	Juvenile steelhead rearing

17

1 **Table 11-4-14. Number of Days per Month Required to Trigger Each Level of Concern for Water**  
 2 **Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided**  
 3 **by NMFS and Used in the BDCP Effects Analysis**

Exceedance above Water Temperature Threshold (°F)	Level of Concern			
	None	Yellow	Orange	Red
1	0-9 days	10-14 days	15-19 days	≥20 days
2	0-4 days	5-9 days	10-14 days	≥15 days
3	0 days	1-4 days	5-9 days	≥10 days

4

5 **Table 11-4-15. Differences between Baseline and H3 Scenarios in the Number of Years in Which**  
 6 **Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River**  
 7 **at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. H3	NAA vs. H3
Red	31 (61%)	0 (0%)
Orange	-17 (-100%)	0 (NA)
Yellow	-11 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)

Note: For definitions of levels of concern, see Table 11-4-14.

NA = could not be calculated because the denominator was 0.

8

9 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
 10 during May through September (Table 11-4-16). Total degree-days under H3 would be up to 11%  
 11 lower than under NAA during May and June and up to 11% higher during July through September.

1 **Table 11-4-16. Differences between Baseline and H3 Scenarios in Total Degree-Days (°F-Days) by**  
 2 **Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento**  
 3 **River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
May	Wet	1,065 (282%)	-137 (-9%)
	Above Normal	228 (107%)	-127 (-22%)
	Below Normal	434 (198%)	-29 (-4%)
	Dry	246 (132%)	-168 (-28%)
	Critical	454 (205%)	44 (7%)
	All	2,427 (200%)	-417 (-10%)
June	Wet	500 (130%)	-211 (-19%)
	Above Normal	66 (45%)	-163 (-43%)
	Below Normal	276 (199%)	-76 (-15%)
	Dry	514 (273%)	-20 (-3%)
	Critical	623 (155%)	73 (8%)
	All	1,979 (157%)	-397 (-11%)
July	Wet	653 (126%)	47 (4%)
	Above Normal	347 (428%)	77 (22%)
	Below Normal	591 (402%)	135 (22%)
	Dry	1,313 (466%)	385 (32%)
	Critical	1,776 (216%)	-10 (-0.4%)
	All	4,680 (253%)	634 (11%)
August	Wet	2,091 (300%)	128 (5%)
	Above Normal	830 (203%)	171 (16%)
	Below Normal	1,246 (470%)	211 (16%)
	Dry	2,063 (308%)	453 (20%)
	Critical	2,732 (184%)	113 (3%)
	All	8,962 (254%)	1,076 (9%)
September	Wet	806 (109%)	97 (7%)
	Above Normal	586 (82%)	186 (17%)
	Below Normal	1,570 (210%)	424 (22%)
	Dry	2,425 (190%)	-171 (-4%)
	Critical	1,938 (93%)	47 (1%)
	All	7,325 (132%)	583 (5%)

4  
 5 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
 6 Sacramento River under H3 would be lower or similar to mortality under NAA except in below  
 7 normal and dry water years (76% and 11% greater, respectively), although the absolute increase in  
 8 these water years would be only 1% (Table 11-4-17). Therefore, the increase in mortality from NAA  
 9 to H3, although relatively large, would be negligible at an absolute scale to the winter-run  
 10 population.

1 **Table 11-4-17. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook**  
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	1 (262%)	-0.1 (-4%)
Above Normal	2 (340%)	-0.1 (-3%)
Below Normal	2 (228%)	1 (76%)
Dry	7 (436%)	1 (11%)
Critical	42 (156%)	-2 (-3%)
All	9 (185%)	0.1 (1%)

3  
4 SacEFT predicts that there would be a 28% decrease in the percentage of years with good spawning  
5 availability, measured as weighted usable area, under H3 relative to NAA (Table 11-4-18). On an  
6 absolute scale, this reduction would be small (9% lower). SacEFT predicts that the percentage of  
7 years with good (lower) redd scour risk, good (lower) redd dewatering risk, and good egg  
8 incubation conditions under H3 would be similar to the percentage of years under NAA. These  
9 results indicate that there would be a small negative effect of H3 on spawning habitat, but no effects  
10 on other modeled parameters.

11 The biological significance of a reduction in available suitable spawning habitat varies at the  
12 population level in response to a number of factors, including adult escapement. For those years  
13 when adult escapement is less than the carrying capacity of the spawning habitat, a reduction in  
14 area would have little or no population level effect. In years when escapement exceeds carrying  
15 capacity of the reduced habitat, competition among spawners for space (e.g., increased redd  
16 superimposition) would increase, resulting in reduced reproductive success. The reduction in the  
17 frequency of years in which spawning habitat availability is considered to be good by SacEFT could  
18 result in reduced reproductive success and abundance of winter-run Chinook salmon if the number  
19 of spawners is limited by spawning habitat quantity.

20 **Table 11-4-18. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
21 **for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. H3	NAA vs. H3
Spawning WUA	-35 (-60%)	-9 (-28%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-25 (-26%)	-2 (-3%)
Redd Dewatering Risk	3 (12%)	-1 (-3%)
Juvenile Rearing WUA	-24 (-48%)	1 (4%)
Juvenile Stranding Risk	0 (0%)	-11 (-35%)

WUA = Weighted Usable Area.

22

### 23 **H1/LOS**

24 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H1 between  
25 May and September would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
26 *Results utilized in the Fish Analysis*). Further, May storage in Shasta Reservoir under H1 would be  
27 similar to storage under H3 (Table 11-4-19).

1 **Table 11-4-19. Difference and Percent Difference in May Water Storage Volume (thousand**  
2 **acre-feet) in Shasta Reservoir for H1, H3, and H4 Scenarios**

Water Year	H3 vs. H1	H3 vs. H4
Wet	-1 (-0.02%)	15 (0.4%)
Above Normal	7 (0.2%)	17 (0.4%)
Below Normal	34 (0.9%)	149 (3.9%)
Dry	115 (3.6%)	117 (3.6%)
Critical	32 (1.8%)	148 (8.1%)

3  
4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
5 examined during the May through September winter-run spawning period (Appendix 11D,  
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
8 NAA and H1 in any month or water year type throughout the period at either location.

9 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
10 determined for each month (May through September) and year of the 82-year modeling period  
11 (Table 11-4-13). The combination of number of days and degrees above the 56°F threshold were  
12 further assigned a “level of concern”, as defined in Table 11-4-14. Differences between baselines and  
13 H1 in the highest level of concern across all months and all 82 modeled years are presented in Table  
14 11-4-20. There would be no difference in levels of concern between NAA and H1.

15 **Table 11-4-20. Differences between Baseline Scenarios and H1 and H4 Scenarios in the Number of**  
16 **Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**  
17 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING		EXISTING	
	CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
Red	31 (61%)	0 (0%)	30 (59%)	-1 (-1%)
Orange	-17 (-100%)	0 (NA)	-16 (-94%)	1 (NA)
Yellow	-11 (-100%)	0 (NA)	-11 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)	-3 (-100%)	0 (NA)

Note: For definitions of levels of concern, see Table 11-4-14.  
NA = could not be calculated because the denominator was 0.

18  
19 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
20 during May through September (Table 11-4-21). Total degree-days under H1 would be up to 11% to  
21 12% lower than under NAA during May and June and 8% to 16% higher during July through  
22 September.

1 **Table 11-4-21. Differences between Baseline Scenarios and H1 and H4 Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**  
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
May	Wet	1,050 (279%)	-152 (-10%)	1,109 (294%)	-93 (-6%)
	Above Normal	273 (128%)	-82 (-14%)	290 (136%)	-65 (-11%)
	Below Normal	429 (196%)	-34 (-5%)	493 (225%)	30 (4%)
	Dry	216 (116%)	-198 (-33%)	392 (211%)	-22 (-4%)
	Critical	428 (194%)	18 (3%)	392 (177%)	-18 (-3%)
	All	2,396 (197%)	-448 (-11%)	2,676 (220%)	-168 (-4%)
June	Wet	468 (122%)	-243 (-22%)	645 (168%)	-66 (-6%)
	Above Normal	91 (61%)	-138 (-37%)	247 (167%)	18 (5%)
	Below Normal	245 (176%)	-107 (-22%)	374 (269%)	22 (4%)
	Dry	458 (244%)	-76 (-11%)	576 (306%)	42 (6%)
	Critical	671 (167%)	121 (13%)	607 (151%)	57 (6%)
	All	1,933 (153%)	-443 (-12%)	2,449 (194%)	73 (2%)
July	Wet	658 (127%)	52 (5%)	633 (122%)	27 (2%)
	Above Normal	352 (435%)	82 (23%)	299 (369%)	29 (8%)
	Below Normal	621 (422%)	165 (27%)	506 (344%)	50 (8%)
	Dry	1,162 (412%)	234 (19%)	1,033 (366%)	105 (9%)
	Critical	1,731 (210%)	-55 (-2%)	1,438 (175%)	-348 (-13%)
	All	4,524 (244%)	478 (8%)	3,909 (211%)	-137 (-2%)
August	Wet	2,153 (309%)	190 (7%)	1,861 (267%)	-102 (-4%)
	Above Normal	816 (200%)	157 (15%)	593 (145%)	-66 (-6%)
	Below Normal	1,302 (491%)	267 (21%)	1,010 (381%)	-25 (-2%)
	Dry	2,003 (299%)	393 (17%)	1,577 (235%)	-33 (-1%)
	Critical	2,605 (175%)	-14 (-0.3%)	2,284 (154%)	-335 (-8%)
	All	8,879 (252%)	993 (9%)	7,325 (208%)	-561 (-5%)
September	Wet	2,321 (314%)	1,612 (111%)	681 (92%)	-28 (-2%)
	Above Normal	1,025 (144%)	625 (56%)	406 (57%)	6 (1%)
	Below Normal	1,278 (171%)	132 (7%)	1,289 (173%)	143 (8%)
	Dry	2,206 (173%)	-390 (-10%)	2,178 (171%)	-418 (-11%)
	Critical	1,843 (89%)	-48 (-1%)	1,691 (81%)	-200 (-5%)
	All	8,673 (156%)	1,931 (16%)	6,245 (112%)	-497 (-4%)

4

5 **H4/HOS**

6 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H4 between  
 7 May and September would generally be similar to flows under H3, except during May and June  
 8 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During May and June, flows  
 9 would be up to 13% lower under H4 than under H3, although these reductions are too low of  
 10 magnitude to have a biologically meaningful effect on winter-run Chinook salmon spawning and egg  
 11 incubation habitat. Further, May storage in Shasta Reservoir under H4 would be similar to storage  
 12 under H3 (Table 11-4-19).

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
2 examined during the May through September winter-run spawning period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 NAA and H4 in any month or water year type throughout the period at either location.

6 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
7 determined for each month (May through September) and year of the 82-year modeling period  
8 (Table 11-4-13). The combination of number of days and degrees above the 56°F threshold were  
9 further assigned a “level of concern”, as defined in Table 11-4-14. Differences between baselines and  
10 H4 in the highest level of concern across all months and all 82 modeled years are presented in Table  
11 11-4-20. There would be no difference in levels of concern between NAA and H4.

12 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
13 during May through September (Table 11-4-21). Total degree-days under H4 would be up to 5%  
14 lower than under NAA during August and similar during other months.

15 **NEPA Effects:** Alternative 4 does not propose any changes in Shasta Reservoir operating criteria,  
16 and CALSIM results show that Reclamation could operate Shasta in such a manner that it does not  
17 affect upstream storage or flows substantially as compared to the NAA. Available analytical tools  
18 show conflicting results regarding the temperature effects of relatively small changes in predicted  
19 summer and fall flows. Several models (CALSIM, SRWQM, and Reclamation Egg Mortality Model)  
20 generally show no change in upstream conditions as a result of Alternative 4. However, one model,  
21 SacEFT, shows adverse effects under some conditions. After extensive investigation of these results,  
22 they appear to be a function of high model sensitivity to relatively small changes in estimated  
23 upstream conditions, which may or may not accurately predict adverse effects. Temperature and  
24 end of September storage criteria from the NMFS (2009a) BiOp for Shasta reservoir are maintained,  
25 in order to minimize adverse effects to spawning and incubating salmonids including winter-run-  
26 run Chinook salmon. However, the new NDD structures allow for spring time deliveries of water  
27 south of the Delta that are currently constrained under the NAA. For this reason, additional spring  
28 storage criteria may be necessary to ensure Shasta operations similar to what was modeled. These  
29 discussions will occur in the Section 7 consultation with Reclamation on Shasta and system-wide  
30 operations, which is outside the scope of BDCP. In conclusion, Alternative 4 modeling results  
31 support a finding that effects are uncertain. Alternative 4 does not propose any changes to Shasta  
32 operating criteria, but modeled results are mixed and operations that match the CALSIM modeling  
33 are not assured. Model results will be submitted to independent peer review to confirm that adverse  
34 effects are not reasonably anticipated to occur.

35 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
36 and quality of spawning and egg incubation habitat for winter-run Chinook salmon would not  
37 change relative to Existing Conditions.

### 38 H3/ESO

39 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined  
40 during the May through September winter-run spawning and egg incubation period (Appendix 11C,  
41 *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Keswick under H3 combined with  
42 climate change, during May and June would generally be up to 22% greater than flows under  
43 Existing Conditions, lower by up to 29% during August and September, and similar during July with  
44 some exceptions. Flows upstream of Red Bluff under H3 during May and June would generally be up

1 to 20% greater than flows under Existing Conditions, up to 26% lower during August, and similar  
2 during July and September, with some exceptions.

3 Shasta Reservoir storage volume at the end of May under H3 combined with climate change, would  
4 be similar to storage under Existing Conditions in wet and above normal water years and 8% to  
5 25% lower in below normal, dry, and critical water years (Table 11-4-12). This indicates that there  
6 would be a small to moderate effect of H3 on flows during the spawning and egg incubation period  
7 in drier water years.

8 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
9 examined during the May through September winter-run spawning period (Appendix 11D,  
10 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
11 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
12 Existing Conditions and H3 during May and June. Mean monthly water temperature would be up to  
13 14% higher under H3 in July through September depending on month, water year type, and location.

14 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
15 determined for each month (May through September) and year of the 82-year modeling period  
16 (Table 11-4-13). The combination of number of days and degrees above the 56°F threshold were  
17 further assigned a “level of concern”, as defined in Table 11-4-14. The number of years classified as  
18 “red” would increase by 61% under H3 relative to Existing Conditions (Table 11-4-15).

19 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
20 during May through September (Table 11-4-16). Total degree-days under H3 would be 132% to  
21 273% higher than that under Existing Conditions depending on month throughout the period.

22 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the  
23 Sacramento River under H3 would be 156% to 436% greater (relative scale) than mortality under  
24 Existing Conditions depending on water year type (Table 11-4-17). However, only in dry (7%  
25 higher) and critical (42% higher) years would the increase be >5% of the winter-run population on  
26 an absolute scale and, therefore, be biologically meaningful. Overall, these results indicate that H3, in  
27 combination with climate change effects, would cause increased winter-run Chinook salmon  
28 mortality in the Sacramento River in drier years.

29 SacEFT predicts that there would be a 60% decrease in the percentage of years with good spawning  
30 availability, measured as weighted usable area, under H3 relative to Existing Conditions (Table 11-  
31 4-18) as a result of the combined effects of climate change and Alternative 4. SacEFT predicts that  
32 the percentage of years with good (lower) redd scour risk under H3 and climate change would be  
33 similar to the percentage of years under Existing Conditions. SacEFT predicts that the percentage of  
34 years with good egg incubation conditions under H3 and climate change would be 26% lower than  
35 under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd  
36 dewatering risk under H3 and climate change would be 12% greater than the percentage of years  
37 under Existing Conditions. These results indicate that Alternative 4, in combination with climate  
38 change effects which are the primary driver for these changes, would cause a large reduction in  
39 spawning WUA and egg incubation conditions.

## 40 H1/LOS

41 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H1 between  
42 May and September would generally be similar to flows under H3 (Appendix 11C, CALSIM II Model

1 Results utilized in the Fish Analysis). Also, May storage in Shasta Reservoir under H1 would be  
2 similar to storage under H3 (Table 11-4-19).

3 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
4 examined during the May through September winter-run spawning period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). Mean monthly water temperature would be up to 13% higher under H1 in July  
7 through September depending on month, water year type, and location.

8 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
9 determined for each month (May through September) and year of the 82-year modeling period  
10 (Table 11-4-13). The combination of number of days and degrees above the 56°F threshold were  
11 further assigned a “level of concern”, as defined in Table 11-4-14. Differences between baselines and  
12 H1 in the highest level of concern across all months and all 82 modeled years are presented in Table  
13 11-4-20. There would be a 61% increase in the number of years with a red level of concern under  
14 H1 relative to Existing Conditions.

15 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
16 during May through September (Table 11-4-21). Total degree-days under H1 would be 153% to  
17 252% higher than under Existing Conditions depending on month.

#### 18 **H4/HOS**

19 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H4 between  
20 May and September would generally be similar to flows under H3, except during May and June  
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During these months, flows  
22 would be up to 13% lower under H4 than under H3, although these reductions are too low of  
23 magnitude to have a biologically meaningful effect on winter-run Chinook salmon spawning and egg  
24 incubation habitat. Additionally, May storage in Shasta Reservoir under H4 would be similar to  
25 storage under H3 in all water years except critical, in which storage under H4 would be 8% greater  
26 than storage under H3 (Table 11-4-19). Mean monthly water temperatures in the Sacramento River  
27 at Keswick and Bend Bridge were examined during the May through September winter-run  
28 spawning period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
29 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be  
30 up to 12% higher under H4 in July through September depending on month, water year type, and  
31 location.

32 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
33 determined for each month (May through September) and year of the 82-year modeling period  
34 (Table 11-4-13). The combination of number of days and degrees above the 56°F threshold were  
35 further assigned a “level of concern”, as defined in Table 11-4-14. Differences between baselines and  
36 H4 in the highest level of concern across all months and all 82 modeled years are presented in Table  
37 11-4-20. There would be a 59% increase in the number of years with a red level of concern under  
38 H4 relative to Existing Conditions.

39 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type  
40 during May through September (Table 11-4-21). Total degree-days under H4 would be 112% to  
41 220% higher than under Existing Conditions depending on month.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between  
3 the CEQA baseline and Alternative 4 could be significant because, when compared to the CEQA  
4 baseline, the alternative could substantially reduce suitable spawning habitat and substantially  
5 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth  
6 above, which is directly related to the inclusion of climate change effects in Alternative 4.

7 Egg mortality (according to the Reclamation egg mortality model) in drier water years, during which  
8 winter-run Chinook salmon would already be stressed due to reduced flows and increased  
9 temperatures, would be up to 42% greater under Alternative 4, including climate change, compared  
10 to the CEQA baseline (Table 11-4-17). Egg incubation conditions according to the SacEFT model are  
11 predicted to be 26% lower under H3, including climate change, than under the CEQA baseline.  
12 Further, the extent of spawning habitat predicted by SacEFT would be 60% lower under H3,  
13 including climate change, compared to the CEQA baseline (Table 11-4-18), which represents a  
14 substantial reduction in spawning habitat and, therefore, in adult spawner and redd carrying  
15 capacity. Exceedances above NMFS temperature thresholds would be substantially greater under  
16 Alternative 4 relative to the CEQA baseline. Conditions under H4 would generally be similar under  
17 H1 and H4 to those under H3, although May storage and flows would be slightly higher under H4  
18 and temperatures would be lower under H1 during spring but higher during fall.

19 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
20 change, future water demands, and implementation of the alternative. The analysis described above  
21 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
22 alternative from those of sea level rise, climate change and future water demands using the model  
23 simulation results presented in this chapter. However, the increment of change attributable to the  
24 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
25 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
26 implementation period, which does include future sea level rise, climate change, and water  
27 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
28 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
29 effect of the alternative from those of sea level rise, climate change, and water demands.

30 The additional comparison of CALSIM flow and reservoir storage outputs between Existing  
31 Conditions in the late long-term implementation period and H3 indicates that flows and reservoir  
32 storage in the locations and during the months analyzed above would generally be similar between  
33 future conditions without the alternative (NAA) and H3. This indicates that the differences between  
34 Existing Conditions and Alternative 4 found above would generally be due to climate change, sea  
35 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding  
36 Alternative 4, if adjusted to exclude sea level rise and climate change, is similar to the NEPA  
37 conclusion, and therefore would not in itself result in a significant impact on spawning habitat for  
38 winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is  
39 required.

40 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
41 **(Winter-Run ESU)**

42 In general, Alternative 4 would not adversely affect rearing habitat for fry and juvenile winter-run  
43 Chinook salmon relative to the NAA.

1       **H3/ESO**

2       Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
3       salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
4       *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing  
5       habitat. Flows under H3 during August through October and December would generally be similar  
6       to flows under NAA with few exceptions. Flows during November under H3 would generally be 5%  
7       to 18% lower than flows under NAA. This reduction in flow during 1 of 5 months of the rearing  
8       period is not expected to have a biologically meaningful effect on rearing juvenile winter-run  
9       Chinook salmon due to limited duration and magnitude.

10       Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
11       examined during the August through December winter-run juvenile rearing period (Appendix 11D,  
12       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
13       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
14       NAA and H3 in any month or water year type throughout the period at either location.

15       SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
16       measured as weighted usable area, under H3 would not differ from the percentage of years  
17       under NAA (Table 11-4-18). In addition, the percentage of years with good (low) juvenile stranding  
18       risk under H3 is predicted to be 35% lower than under NAA. On an absolute scale, the reduction in  
19       juvenile stranding risk would be small (11%) and would not have a biologically meaningful effect on  
20       winter-run Chinook salmon. These results indicate that neither the quantity nor quality of juvenile  
21       rearing habitat in the Sacramento River would differ between NAA and H3.

22       SALMOD predicts that winter-run smolt equivalent habitat-related mortality under H3 would be 5%  
23       higher than under NAA. These results are somewhat inconsistent with SacEFT results, which  
24       indicate that juvenile stranding risk would increase under H3 (Table 11-4-18). However, the  
25       increase in juvenile stranding risk predicted by SacEFT is small on an absolute scale (11% lower)  
26       and would not affect winter-run Chinook salmon at a population scale, which is more consistent  
27       with SALMOD results. Both SacEFT and SALMOD are considered to be reliable models for winter-run  
28       Chinook salmon in the Sacramento River. SALMOD has been used for decades for assessing changes  
29       in flows associated with SWP and CVP. Therefore, results of both models were used to draw  
30       conclusions about winter-run Chinook salmon rearing conditions.

31       **H1/LOS**

32       Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H1 between  
33       August and December would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
34       *Results utilized in the Fish Analysis*), with exceptions during some months and water year types.  
35       However, these reductions would be too infrequent or of too low of magnitude to have biologically  
36       meaningful effects on winter-run Chinook salmon.

37       Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
38       examined during the August through December winter-run juvenile rearing period (Appendix 11D,  
39       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
40       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
41       NAA and H1 in any month or water year type throughout the period at either location.

1 **H4/HOS**

2 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H4 between  
3 August and December would generally be similar to or greater than flows under H3 (Appendix 11C,  
4 *CALSIM II Model Results utilized in the Fish Analysis*).

5 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
6 examined during the August through December winter-run juvenile rearing period (Appendix 11D,  
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
8 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
9 NAA and H4 in any month or water year type throughout the period at either location.

10 **NEPA Effects:** Collectively, these results indicate that the effect of Alternative 4 is not adverse  
11 because it does not have the potential to substantially reduce the amount of suitable habitat or  
12 substantially interfere with winter-run Chinook salmon rearing. Differences in flows and  
13 temperatures are generally small and inconsistent among months and water year types. SALMOD  
14 and SacEFT predicted contradicting results regarding habitat-related mortality although the  
15 magnitude of effect predicted by both models would not be biologically meaningful. There would be  
16 no differences between scenarios.

17 **CEQA Conclusion:** In general, Alternative 4 would not reduce the quantity and quality of fry and  
18 juvenile rearing habitat for winter-run Chinook salmon relative to Existing Conditions.

19 **H3/ESO**

20 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook  
21 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*  
22 *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing  
23 habitat. Flows under H3 during August and November would generally be lower by up to 26% than  
24 flows under Existing Conditions and similar to flows under Existing Conditions during September,  
25 October, and December.

26 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
27 examined during the August through December winter-run rearing period (Appendix 11D,  
28 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
29 *Fish Analysis*). Mean monthly water temperature would be higher (by up to 14%, but generally less  
30 than 8%) under H3 in August through October depending on month, water year type, and location.  
31 There would be no differences (<5%) between Existing Conditions and H3 in mean monthly water  
32 temperature during July, November, and December at either location.

33 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
34 measured as weighted usable area, under H3, combined with climate change, would be 48% lower  
35 than under Existing Conditions (Table 11-4-18). The percentage of years with good (low) juvenile  
36 stranding risk under H3 is predicted to be identical to the percentage under Existing Conditions.  
37 This indicates that the amount of juvenile rearing habitat in the Sacramento River would be lower  
38 under H3 relative to Existing Conditions, but juvenile stranding risk would be similar between  
39 scenarios

40 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under H3 would be 6%  
41 higher than under Existing Conditions. These results are inconsistent with SacEFT results, which  
42 indicate that juvenile rearing WUA would be substantially reduced by H3 (Table 11-4-18). Both

1 SacEFT and SALMOD are considered to be reliable models for winter-run Chinook salmon in the  
2 Sacramento River. SALMOD has been used for decades for assessing changes in flows associated  
3 with SWP and CVP. Therefore, results of both models were used to draw conclusions about winter-  
4 run Chinook salmon rearing conditions.

#### 5 **H1/LOS**

6 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H1 between  
7 August and December would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
8 *Results utilized in the Fish Analysis*), with exceptions during some months and water year types.  
9 However, these reductions would be too infrequent or of too low of magnitude to have biologically  
10 meaningful effects on winter-run Chinook salmon.

11 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
12 examined during the August through December winter-run rearing period (Appendix 11D,  
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
14 *Fish Analysis*). Mean monthly water temperature would be higher (by up to 13%, but generally less  
15 than 8%) under H1 in August through October depending on month, water year type, and location.  
16 There would be no differences (<5%) between Existing Conditions and H1 in mean monthly water  
17 temperature during July, November, and December at either location.

#### 18 **H4/HOS**

19 Flows in the Sacramento River between Keswick and Red Bluff Diversion Dam under H4 between  
20 August and December would generally be similar to or greater than flows under H3 (Appendix 11C,  
21 *CALSIM II Model Results utilized in the Fish Analysis*).

22 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
23 examined during the August through December winter-run rearing period (Appendix 11D,  
24 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
25 *Fish Analysis*). Mean monthly water temperature would be higher (by up to 12%, but generally less  
26 than 8%) under H4 in August through October depending on month, water year type, and location.  
27 There would be no differences (<5%) between Existing Conditions and H4 in mean monthly water  
28 temperature during July, November, and December at either location.

#### 29 **Summary of CEQA Conclusion**

30 These results indicate that the impact would be less than significant because it does not have the  
31 potential to substantially reduce the amount of suitable habitat and substantially interfere with the  
32 movement of fish, and no mitigation is necessary. Flows are generally comparable between  
33 Alternative 4 and Existing Conditions and there would be small increases under the alternative in  
34 water temperatures during some of the period of presence. SALMOD and SacEFT predicted  
35 contradicting results regarding habitat-related mortality. Overall, the impact would be less than  
36 significant. There would be no differences between scenarios.

#### 37 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon** 38 **(Winter-Run ESU)**

39 In general, the effects of Alternative 4 on winter-run Chinook salmon migration conditions relative  
40 to the NAA are uncertain.

1 **Upstream of the Delta**

2 **H3/ESO**

3 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November  
4 juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). A  
5 reduction in flow may reduce the ability of juvenile winter-run to migrate effectively through the  
6 Sacramento River. Flows under H3 would be 5% to 18% lower than under NAA during November  
7 and generally similar to NAA during the rest of the juvenile winter-run Chinook salmon migration  
8 period (July through October).

9 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
10 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
11 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
12 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
13 NAA and H3 in any month or water year type throughout the period at either location.

14 Flows in the Sacramento River upstream of Red Bluff during the adult winter-run Chinook salmon  
15 upstream migration period (December through August) under H3 would generally be similar to  
16 those under NAA, except during May and June in which flows would be up to 12% greater than flows  
17 under NAA.

18 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
19 examined during the December through August winter-run upstream migration period (Appendix  
20 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
21 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
22 between NAA and H3 in any month or water year type throughout the period at either location.

23 **H1/LOS**

24 Flows in the Sacramento River upstream of Red Bluff during the July through November juvenile  
25 emigration period under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*) except in wetter water year types during September and  
27 November. Reductions during November would be too low of magnitude (3% to 12% lower) to have  
28 biologically meaningful effects on emigrating juveniles. Flow reductions during both months would  
29 occur only during wetter water years when flow reductions are less critical to emigrating juveniles  
30 and, therefore, would not cause biologically meaningful effects.

31 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
32 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
34 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
35 NAA and H1 in any month or water year type throughout the period at either location.

36 Flows in the Sacramento River upstream of Red Bluff during the adult winter-run Chinook salmon  
37 upstream migration period (December through August) would generally be similar to or greater  
38 than flows under H3.

39 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
40 examined during the December through August winter-run upstream migration period (Appendix  
41 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*

1 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
2 between NAA and H4 in any month or water year type throughout the period at either location.

### 3 **H4/HOS**

4 Flows in the Sacramento River upstream of Red Bluff during the July through November juvenile  
5 emigration period under H4 would generally be similar to or greater than flows under H3 (Appendix  
6 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
8 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
10 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
11 NAA and H1 in any month or water year type throughout the period at either location.

12 Flows in the Sacramento River upstream of Red Bluff during the adult winter-run Chinook salmon  
13 upstream migration period (December through August) would generally be similar to flows under  
14 H3, except during June in which flows would be up to 12% lower under H4 and during August, in  
15 which flows would be up to 13% greater under H4. These flow reductions and increases would not  
16 be of sufficient frequency or magnitude to cause biologically meaningful effects on migrating adults.

17 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
18 examined during the December through August winter-run upstream migration period (Appendix  
19 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
20 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
21 between NAA and H4 in any month or water year type throughout the period at either location.

### 22 **Through-Delta**

#### 23 **H3/ESO**

#### 24 **Juveniles**

25 Plan Area flows have considerable importance for downstream migrating juvenile salmonids and  
26 would be affected by the north Delta diversions, as discussed above for winter-run Chinook above  
27 (Impact AQUA-42 for Alternative 1A). Average monthly flows Sacramento River flows below the  
28 NDD under H3 for juvenile winter-run migrants (November through May) would be reduced 11% to  
29 23% compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Note  
30 that *CM1 Water Facilities and Operation* includes bypass flow criteria that will be managed in real  
31 time to minimize adverse effects of diversions at the north Delta intakes on downstream-migrating  
32 salmonids.

33 Potential predation effects at the north Delta intakes could occur if predatory fish aggregated along  
34 the screens as has been observed at other long screens in the Central Valley (Vogel 2008). Baseline  
35 levels of predation are uncertain, however. Analysis by a bioenergetics model (Appendix 5.F,  
36 *Biological Stressors on Covered Fish*, Section 5.F.3.2.1) suggests that considerably less than 0.3% of  
37 winter-run juveniles could be preyed upon (Table 11-4-22). Using another scenario of predation  
38 that assumes a 5% loss per intake (based on GCID losses, Vogel 2008) would yield a cumulative loss  
39 of about 12% of the annual production that reaches the north Delta. The three intake structures  
40 would also permanently displace approximately 13.7 acres of in-water habitat and 7,450 linear feet  
41 of shoreline along the migration route. However, there are appreciable uncertainties in these

1 analyses, including unknown baseline levels of predation, uncertainty in the bioenergetics model  
2 parameters, and the comparability of the GCID intakes for estimating loss rates. This is discussed in  
3 detail in Alternative 1A.

4 **Table 11-4-22. Winter-Run Chinook Salmon Predation Loss at the Proposed North Delta Diversion**  
5 **Intakes (Three Intakes for Alternative 4)**

Striped Bass at NDD (Three Intakes)			Winter-Run Chinook Consumed	
Density Assumption	Bass per 1,000 Feet of Intake	Total Number of Bass	Number	Percentage of Annual Juvenile Production
Low	18	86	648	0.02%
Median	119	571	4,283	0.16%
High	219	1,051	7,881	0.30%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

6  
7 Through-Delta survival by juvenile winter-run Chinook salmon, as estimated by the Delta Passage  
8 Model under Scenario H3, averaged 33.2% across all years, 26% in drier years up to 45.3% in wetter  
9 years (for further details, refer to *BDCP Appendix 5.C, Section 5C.5.3.1.3.1*). Average juvenile survival  
10 under H3 was similar or slightly lower than NAA (1% less, a 3% relative decrease) (Table 11-4-23).

11 **Table 11-4-23. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under**  
12 **Alternative 4 (Scenarios H3, H1, and H4)**

Water Year Type	Average Percentage Survival					Difference in Percentage Survival (Relative Difference)					
	SCENARIO					EXISTING CONDITIONS vs. Alt 4 Scenario			NAA vs. Alt 4 Scenario		
	EXISTING CONDITIONS	NAA	H3	H1	H4	H3	H1	H4	H3	H1	H4
Wetter Years	46.3	46.1	45.3	45.2	46.0	-1.1 (-2%)	-1.1 (-2%)	-0.3 (-1%)	-0.8 (-2%)	-0.9 (-2%)	-0.1 (0%)
Drier Years	28.0	27.1	26.0	26.1	25.7	-2.0 (-7%)	-1.9 (-7%)	-2.3 (-8%)	-1.1 (-4%)	-1.0 (-4%)	-1.4 (-5%)
All Years	34.9	34.2	33.2	33.3	33.3	-1.6 (-5%)	-1.6 (-5%)	-1.6 (-5%)	-1.0 (-3%)	-0.9 (-3%)	-0.9 (-3%)

Note: Average Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal Water Years (6 years).

Drier = Below Normal, Dry and Critical Water Years (10 years).

H3 = ESO operations, H1 = Low Outflow, H4 = High Outflow.

13  
14 **Adults**  
15 Adult salmonids migrating through the delta use flow and olfactory cues for navigation to their natal  
16 streams (Marston et al. 2012), as discussed above for winter-run Chinook (Impact AQUA-42 for  
17 Alternative 1A). The importance of flow changes to currently affect these cues is rated as low but  
18 with low certainty. Attraction flows and olfactory cues in the west Delta would be altered because of  
19 shifts in exports from the south Delta to the north Delta. Flows in the Sacramento River downstream  
20 of the north Delta intake diversions would be reduced, with concomitant proportional increases in

San Joaquin River flow, with differences between water-year types because of differences in the relative proportion of water being exported from the north Delta and south Delta facilities (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

These changes would slightly decrease the Sacramento River olfactory cues used by migrating adults. Fingerprint analyses determined that attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, declined from NAA to Scenario H3 operations by up to 4% during the peak migration period for winter-run adults (December through February) (Table 11-4-24). The flow changes under Scenario H3 would slightly decrease the olfactory cues for migrating adult salmon in the Sacramento River (by 9% or less compared to NAA). Nevertheless, the Sacramento River would still represent a substantial proportion of Delta outflows. Under Scenario H4, the difference would be less due to increased spring outflows in March, April, and May. Scenario H1 results would be similar to Scenario H3. Overall, the reductions in olfactory cues resulting from all scenarios would be less than the magnitude of change in dilution (20% or more) reported to cause a significant change in migration by Fretwell (1989) and, therefore, are not expected to affect adult Chinook salmon migration. However, uncertainty remains with regard to adult salmon behavioral response to anticipated changes in lower Sacramento River flow percentages. This topic is discussed further in Impact AQUA-42 for Alternative 1A.

**Table 11-4-24. Percentage (%) of Water at Collinsville that Originated in the Sacramento River during the Adult Winter-Run Chinook Salmon Migration Period for Alternative 4 (Scenario H3)**

Month	EXISTING CONDITIONS	NAA	H3	EXISTING CONDITIONS vs. H3	NAA vs. H3
December	67	66	66	-1	0
January	76	75	73	-3	-2
February	75	72	68	-7	-4
March	78	76	68	-10	-8
April	77	75	66	-11	-9
May	69	65	59	-10	-6
June	64	62	58	-6	-4
July	64	65	56	-8	-9

Shading indicates 10% or greater difference.

**H1/LOS**

**Juveniles**

Plan Area flows have considerable importance for downstream migrating juvenile salmonids and would be affected by the north Delta diversions, as discussed above for winter-run Chinook above (Impact AQUA-42 for Alternative 1A). Under H1, Sacramento River flows below the NDD during the juvenile winter-run migration period (November-May) would be reduced compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Note that *CM1 Water Facilities and Operation* includes bypass flow criteria that will be managed in real time to minimize adverse effects of diversions at the north Delta intakes on downstream-migrating salmonids.

Through-Delta survival by juvenile winter-run Chinook salmon under Scenario H1 averaged 33.3% across all years, 26.1% in drier years up to 45.2% in wetter years (for further details, refer to *BDCP*

1 *Appendix 5.C, Section 5C.5.3.1.3.1*). Average survival under Scenario H1 was generally similar to NAA  
2 (Table 11-4-23).

3 Overall, the similarity in through-Delta survival these scenarios is explained by the relatively low  
4 overlap of the winter-run Delta entry distribution with the spring period that has differing outflows  
5 for the Alternative 4 operations scenarios. In addition, the DPM has less representation of  
6 intermediate-outflow years where the differences among the Alternative 4 operations scenarios are  
7 more pronounced than wetter or drier years.

#### 8 **Adults**

9 Results for H1 regarding attraction flows and olfactory cues are presented as part of the  
10 corresponding discussion under H3.

#### 11 **H4/HOS**

#### 12 **Juveniles**

13 Plan Area flows have considerable importance for downstream migrating juvenile salmonids and  
14 would be affected by the north Delta diversions, as discussed above for winter-run Chinook above  
15 (Impact AQUA-42 for Alternative 1A). Under H4, Sacramento River flows below the NDD during the  
16 juvenile winter-run migration period (November–May) would be reduced 5% to 23% compared to  
17 NAA (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). Note that *CM1 Water*  
18 *Facilities and Operation* includes bypass flow criteria that will be managed in real time to minimize  
19 adverse effects of diversions at the north Delta intakes on downstream-migrating salmonids.

20 Through-Delta survival by juvenile winter-run Chinook salmon under Scenario H4 averaged 33.3%  
21 across all years, 25.7% in drier years up to 46% in wetter years (for further details, refer to *BDCP*  
22 *Appendix 5.C, Section 5C.5.3.1.3.1*). Average survival under Scenario H4 was generally similar to NAA,  
23 with slightly lower survival for H4 in wetter years (0.9% less, a 3% relative decrease) (Table 11-4-  
24 23).

25 Overall, the similarity in through-Delta survival these scenarios is explained by the relatively low  
26 overlap of the winter-run Delta entry distribution with the spring period that has differing outflows  
27 for the Alternative 4 operations scenarios. In addition, the DPM has less representation of  
28 intermediate-outflow years where the differences among the Alternative 4 operations scenarios are  
29 more pronounced than wetter or drier years.

#### 30 **Adults**

31 Results for H4 regarding attraction flows and olfactory cues are presented as part of the  
32 corresponding discussion under H3.

33 **NEPA Effects:** Upstream of the Delta, the effects of Alternative 4 are uncertain, with the effects  
34 analysis showing conflicting lines of evidence regarding whether or not additional adverse effects  
35 would occur as a result of re-operation of Shasta reservoir. Modeling analyses indicate that some  
36 scenarios of Alternative 4 would potentially improve upstream conditions whereas some scenarios  
37 could degrade upstream conditions compared to NAA. Within the Delta, adult attraction flows under  
38 Alternative 4 would not be substantially different from those under NAA and, therefore, the effects  
39 of Alternative 4 on adult migration would be expected to be similar to NAA.

1 Near-field effects of Alternative 4 NDD on winter-run Chinook salmon related to impingement and  
 2 predation associated with three new intake structures could result in negative effects on juvenile  
 3 migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall  
 4 effects. It is expected that the level of near-field impacts would be directly correlated to the number  
 5 of new intake structures in the river and thus the level of impacts associated with 3 new intakes  
 6 would be considerably lower than those expected from having 5 new intakes in the river. Estimates  
 7 within the effects analysis range from very low levels of effects (<1% mortality) to more significant  
 8 effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the  
 9 intent of providing localized and temporary reductions in predation pressure at the NDD.  
 10 Additionally, several pre-construction surveys to better understand how to minimize losses  
 11 associated with the three new intake structures will be implemented as part of the final NDD screen  
 12 design effort. Alternative 4 also includes an Adaptive Management Program and Real-Time  
 13 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
 14 adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of  
 15 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality  
 16 expected from near-field effects at the NDD remains highly uncertain.

17 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
 18 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
 19 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 4  
 20 predict improvements in smolt condition and survival associated with increased access to the Yolo  
 21 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
 22 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
 23 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

24 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
 25 all of these elements of BDCP operations and conservation measures to predict smolt migration  
 26 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
 27 migration survival under Alternative 4 would be similar to those estimated for NAA. Further  
 28 refinement and testing of the DPM, along with several ongoing and planned studies related to  
 29 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
 30 future. These efforts are expected to improve our understanding of the relationships and  
 31 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
 32 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
 33 However, until these efforts are completed and their results are fully analyzed, the overall  
 34 cumulative effect of Alternative 4 on winter-run Chinook salmon migration remains uncertain.

35 **CEQA Conclusion:** In general, Alternative 4 would not reduce migration conditions for winter-run  
 36 Chinook salmon relative to Existing Conditions.

### 37 **Upstream of the Delta**

#### 38 **H3/ESO**

39 Flows in the Sacramento River upstream of Red Bluff were examined during the July through  
 40 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
 41 Analysis*). A reduction in flow may reduce the ability of juvenile winter-run to migrate effectively  
 42 through the Sacramento River. Flows under H3, combined with climate change, for juvenile migrants  
 43 would be up to 14% lower than under Existing Conditions during November depending on water  
 44 year type. However, flows under H3, combined with climate change, would generally be similar to

1 those under Existing Conditions during the rest of the juvenile winter-run Chinook salmon  
2 migration period (July through October) with few exceptions.

3 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
4 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). Mean monthly water temperature would be higher (by up to 14%, but mostly <8%)  
7 under H3 in August through October depending on month, water year type, and location. There  
8 would be no differences (<5%) in mean monthly water temperature between Existing Conditions  
9 and H3 during July and November.

10 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run  
11 Chinook salmon upstream migration period (December through August). Flows under H3 would  
12 generally be similar to flows under Existing Conditions throughout the adult migration period,  
13 except during May and June, in which flows would be up to 20% greater under H3, combined with  
14 climate change, and during August, in which flows would be up to 26% lower under H3, combined  
15 with climate change. These flow reductions would not be frequent enough to cause a biologically  
16 meaningful effect on adult migrants.

17 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
18 examined during the December through August winter-run upstream migration period (Appendix  
19 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
20 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
21 between Existing Conditions and H3 during December through July. Mean monthly water  
22 temperature would be up to 14% higher under H3 in August depending on water year.

### 23 **H1/LOS**

24 Flows in the Sacramento River upstream of Red Bluff during the July through November juvenile  
25 emigration period under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*) except in wetter water year types during September and  
27 November, as a results of not implementing Fall X2 requirements for delta smelt. Reductions during  
28 November would be too low of magnitude (3% to 12% lower) to have biologically meaningful  
29 effects on emigrating juveniles. Flow reductions during both months would occur only during wetter  
30 water years when flow reductions are less critical to emigrating juveniles and, therefore, would not  
31 cause biologically meaningful effects.

32 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
33 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
35 *Fish Analysis*). Mean monthly water temperature would be higher (by up to 13%, but mostly <8%)  
36 under H1 in August through October depending on month, water year type, and location. There  
37 would be no differences (<5%) in mean monthly water temperature between Existing Conditions  
38 and H1 during July and November.

39 Flows in the Sacramento River upstream of Red Bluff during the adult winter-run Chinook salmon  
40 upstream migration period (December through August) would generally be similar to or greater  
41 than flows under H3.

42 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
43 examined during the December through August winter-run upstream migration period (Appendix

1 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
2 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
3 between Existing Conditions and H1 during December through July. Mean monthly water  
4 temperature would be up to 13% higher under H1 in August depending on water year.

#### 5 **H4/HOS**

6 Flows in the Sacramento River upstream of Red Bluff during the July through November juvenile  
7 emigration period under H4 would generally be similar to or greater than flows under H3 (Appendix  
8 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
10 examined during the July through November winter-run juvenile emigration period (Appendix 11D,  
11 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
12 *Fish Analysis*). Mean monthly water temperature would be higher (by up to 12%, but mostly <8%)  
13 under H4 in August through October depending on month, water year type, and location. There  
14 would be no differences (<5%) in mean monthly water temperature between Existing Conditions  
15 and H4 during July and November.

16 Flows in the Sacramento River upstream of Red Bluff during the adult winter-run Chinook salmon  
17 upstream migration period (December through August) under H4 would generally be similar to  
18 flows under H3, except during June in which flows would be up to 12% lower under H4 and during  
19 August, in which flows would be up to 13% greater under H4. These flow reductions and increases  
20 would not be of sufficient frequency or magnitude to cause biologically meaningful effects on  
21 migrating adults. Water temperatures in the Sacramento River under H4 would be similar to those  
22 under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
24 examined during the December through August winter-run upstream migration period (Appendix  
25 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
26 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
27 between Existing Conditions and H4 during December through July. Mean monthly water  
28 temperature would be up to 12% higher under H4 in August depending on water year.

#### 29 **Through-Delta**

##### 30 ***Juveniles***

31 During the juvenile winter-run Chinook salmon emigration period (November through May), mean  
32 monthly flows in the Sacramento River below the NDD under H3 averaged across years would be  
33 lower (15% to 27% lower monthly mean) compared to Existing Conditions. Potential predation  
34 losses at the three north Delta intakes would range from considerably less than 1% (bioenergetics  
35 modeling) to 11.7% (conservative upper bound based on 5% loss per intake) of the annual  
36 production that reaches the north Delta. In addition, the three intake structures would permanently  
37 displace approximately 13.7 acres of in-water habitat.

38 Through-Delta survival by juvenile winter-run Chinook salmon, as estimated by the Delta Passage  
39 Model under Scenario H3, would be slightly lower than Existing Conditions for H3 (1.6% less, a 5%  
40 relative decrease), with the greatest reduction in drier years (2.0% lower, a 7% relative decrease)  
41 (Table 11-4-23).

1 Under Scenarios H1 and H4, average survival was 1.6% less (5% relative decrease) than Existing  
2 Conditions, with a 2.3% reduction under H4 in drier years (an 8% relative decrease).

3 **Adults**

4 Flows in the Sacramento River downstream of the north Delta intake diversions would be reduced.  
5 These changes would slightly decrease the olfactory cues for migrating adult salmon. Under  
6 Scenario H3, the proportion of Sacramento River water was reduced no more than 7% during peak  
7 migration (December through February) and reduced by 10–11% in March-May compared to  
8 Existing Conditions (Table 11-4-24). Scenario H1 results would be similar to Scenario H3. The  
9 reductions in percentage are small in comparison with the magnitude of change in dilution (20% or  
10 more) reported to cause a significant change in migration by Fretwell (1989) and, therefore, are not  
11 expected to affect adult Chinook salmon migration. The Sacramento River would still represent a  
12 substantial proportion of Delta outflows. However, uncertainty remains with regard to adult salmon  
13 behavioral response to anticipated changes in lower Sacramento River flow percentages. This topic  
14 is discussed further in Impact AQUA-42 for Alternative 1A.

15 **Summary of CEQA Conclusion**

16 Collectively, these results indicate that the effect would be less than significant because it does not  
17 have the potential to substantially reduce migration habitat or substantially interfere with the  
18 movement of fish. Upstream flows and water temperatures would not be difference between  
19 Alternative 4 and Existing Conditions for any scenario. Although upper Sacramento River flows  
20 under Alternative 4 would be lower than under Existing Conditions during August and November,  
21 flows during the remaining months of the juvenile emigration and adult immigration periods would  
22 be similar to or greater than flows under Existing Conditions. Further, winter-run Chinook salmon  
23 juvenile survival through the Delta would be similar between Alternative 4 and Existing Conditions  
24 during all water year types. Due to similarities in migration conditions between Alternative 4 and  
25 Existing Conditions, it is concluded that the impact would be less than significant and no mitigation  
26 would be required.

27 **Restoration Measures (CM2, CM4–CM7, and CM10)**

28 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
29 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
30 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
31 restoration measures described for winter-run Chinook salmon under Alternative 1A (Impacts  
32 AQUA-43 through AQUA-45) also appropriately characterize effects under Alternative 4.

33 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

34 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**  
35 **(Winter-Run ESU)**

36 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**  
37 **Salmon (Winter-Run ESU)**

38 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**  
39 **ESU)**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
2 on winter-run Chinook salmon are the same as those described under Alternative 1A (Impacts  
3 AQUA-43 through AQUA-45). The effects would not be adverse, and would generally be beneficial.  
4 Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to  
5 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on  
6 winter-run Chinook salmon are uncertain.

7 **CEQA Conclusion:** All three of the impact mechanisms listed above would be at least slightly  
8 beneficial, or less than significant, and no mitigation is required, for the reasons identified for  
9 Alternative 1A.

#### 10 **Other Conservation Measures (CM12–CM19 and CM21)**

11 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
12 differences in other conservation-related fish effects are anticipated anywhere in the affected  
13 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
14 effects of other conservation measures described for winter-run Chinook salmon under Alternative  
15 1A (Impacts AQUA-46 through AQUA-54) also appropriately characterize effects under Alternative  
16 4.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 18 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run** 19 **ESU) (CM12)**

#### 20 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon** 21 **(Winter-Run ESU) (CM13)**

#### 22 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-** 23 **Run ESU) (CM14)**

#### 24 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon** 25 **(Winter-Run ESU) (CM15)**

#### 26 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)** 27 **(CM16)**

#### 28 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)** 29 **(CM17)**

#### 30 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)** 31 **(CM18)**

#### 32 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run** 33 **ESU) (CM19)**

#### 34 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon** 35 **(Winter-Run ESU) (CM21)**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms  
2 on winter-run Chinook salmon are the same as those described under Alternative 1A (Impacts  
3 AQUA-46 through AQUA-54). The effects range from no effect, to not adverse, to beneficial.

4 **CEQA Conclusion:** The effects of the nine impact mechanisms listed above range from no impact, to  
5 less than significant, to beneficial, and no mitigation is required.

## 6 **Spring-Run Chinook Salmon**

### 7 **Construction and Maintenance of CM1**

#### 8 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 9 **(Spring-Run ESU)**

10 The potential effects of construction of the water conveyance facilities on spring-run Chinook  
11 salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except Alternative  
12 4 would include three intakes compared to five intakes under Alternative 1A, so the effects would be  
13 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing  
14 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and  
15 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
16 would require 27.3 acres of dredging. Alternative 4 would use five barge locations rather than six as  
17 under Alternative 1A so those effects would also be proportionally less. Additionally, construction  
18 and excavation at Clifton Court Forebay would be done in the dry via installation of cofferdams for  
19 isolation and dewatering of work areas. Implementation of Appendix 3B, *Environmental*  
20 *Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize  
21 adverse effects as described for Alternative 1A. Mitigation measures would also be available to avoid  
22 and minimize potential effects.

23 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-55, the effect would not be adverse for  
24 spring-run Chinook salmon.

25 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-55, the impact of the construction of  
26 water conveyance facilities on spring-run Chinook salmon would not be significant except for  
27 construction noise associated with pile driving. Potential pile driving impacts would be less than  
28 Alternative 1A because only three intakes would be constructed rather than five. Implementation of  
29 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
30 less than significant.

#### 31 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 32 **of Pile Driving and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
34 Alternative 1A.

#### 35 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 36 **and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
38 Alternative 1A.

1 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
2 **(Spring-Run ESU)**

3 **NEPA Effects:** The potential effects of maintenance of the water conveyance facilities under  
4 Alternative 4 would be the same as those described for Alternative 1A (Impact AQUA-56) except  
5 that only three intakes would need to be maintained under Alternative 4 rather than five under  
6 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-56, the impact would not be adverse  
7 for spring-run Chinook salmon.

8 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-56, the impact of maintenance of  
9 the water conveyance facilities on spring-run Chinook salmon would not be significant and no  
10 mitigation is required.

11 **Water Operations of CM1**

12 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**  
13 **ESU)**

14 **Water Exports from SWP/CVP South Delta Facilities**

15 Average entrainment of juvenile spring-run Chinook salmon at the south Delta export facilities  
16 would be reduced 40% under the Scenario H3 compared to NAA (Table 11-4-25). The greatest  
17 reduction would be in wet years, when entrainment would be reduced 63% (~58,000 fish)  
18 compared to NAA. Entrainment loss under Scenario H4 would further reduce south Delta  
19 entrainment relative to the Scenario H3.

20 **Table 11-4-25. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index<sup>a</sup> at the**  
21 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 4 (Scenario**  
22 **H3)**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-54,712 (-62%)	-58,340 (-63%)
Above Normal	-7,576 (-28%)	-10,644 (-36%)
Below Normal	-784 (-12%)	-1,579 (-22%)
Dry	-766 (-5%)	-1,960 (-11%)
Critical	-2,937 (-25%)	-1,316 (-13%)
All Years	-14,145 (-37%)	-15,755 (-40%)

Note: Estimated annual number of fish lost, based on normalized data.

23  
24 The proportion of the annual spring-run Chinook salmon index of abundance (assumed to be  
25 750,000 juveniles approaching the Delta) lost at the south Delta facilities averaged 5.3% across all  
26 years under the NAA, and decreased to 3.2% under Alternative 4 Scenario H3. The greatest  
27 improvement was in wet years, when the proportion lost decreased by 7.8% under Alternative 4  
28 Scenario H3 (4.5%) compared to NAA (12.3%). Entrainment under Scenario H1 would be similar to  
29 Scenario H3, while conditions under Scenario H4 are expected to further reduce entrainment losses  
30 relative to both Scenarios H3 and H1.

**Water Exports from SWP/CVP North Delta Intake Facilities**

The effect of Alternative 4 on entrainment and impingement at the north Delta facilities would be the same as described for Alternative 1A (Impact AQUA-57), but the degree would be less because Alternative 4 would have fewer intakes. State-of-the-art fish screens operated with an adaptive management plan would be expected to eliminate entrainment risk for juvenile spring-run Chinook salmon.

**Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

Entrainment to the NBA would be the same as described for Alternative 1A (Impact AQUA-57). Entrainment and impingement effects would be minimal because intakes on the Sacramento River would have state-of-the-art screens installed.

**Predation Associated with Entrainment**

Entrainment-related predation loss of spring-run Chinook salmon at the south Delta facilities would be no greater and may be lower than baseline due to a reduction in entrainment loss. Entrainment-related predation losses are expected to decrease under Scenario H4 compared to Scenario H3, while conditions under Scenario H1 would be similar to Scenario H3.

Predation at the north Delta would be increased at the proposed North Delta intake facilities on the Sacramento River. Bioenergetics modeling with a median predator density predicts a predation loss of about 8,200 juveniles, or 0.2% of the spring-run juvenile population under Alternative 4 (Table 11-4-26). This is well under the criteria of a 5% population loss, thus the impact from predation loss would not be adverse.

**Table 11-4-26. Juvenile Spring-Run Chinook Salmon Predation Loss at the Proposed North Delta Diversion (NDD) Intakes for Alternative 4 (Three Intakes)**

Striped Bass at NDD (Three Intakes)			Spring-Run Chinook Consumed	
Density Assumption	Bass per 1,000 feet of Intake	Total Number of Bass	Number	Percentage of Annual Juvenile Production
Low	18	86	1,243	0.03%
Median	119	571	8,217	0.20%
High	219	1,051	15,122	0.36%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

**NEPA Effects:** In conclusion, Alternative 4 would reduce overall entrainment losses of juvenile spring-run Chinook salmon relative to NAA. The population benefit would be small because entrainment losses affect about 5% of annual juvenile spring-run Chinook salmon production. Conditions under Scenario H4 would further reduce entrainment losses compared to Scenario H3 and Scenario H1. The effect of Alternative 4 would not be adverse and may provide some benefit.

**CEQA Conclusion:** Entrainment losses of juvenile spring-run Chinook salmon at the south Delta facilities will be substantially reduced under the Scenario H3 operations for Alternative 4 for all water year types (37% average reduction in entrainment index) compared to existing biological conditions (Table 11-4-25). The proportion of the annual spring-run Chinook index of abundance

1 entrained at the south Delta facilities averaged 5.0% across all years under Existing Conditions, and  
 2 would decrease to 3.2% under Alternative 4. The greatest improvement would be in wet years,  
 3 when the proportion lost would decrease by 7% under Scenario H3 (4.5%) compared to Existing  
 4 Conditions (11.8%). Under Scenario H4, entrainment losses are expected to further decrease  
 5 relative to Existing Conditions. Entrainment at the NBA would be minimal. Predation loss at the  
 6 north Delta intakes would have minor population level effects on spring-run Chinook salmon  
 7 (<0.4% of the annual index of abundance). Overall, impacts to spring-run Chinook salmon under  
 8 Alternative 4 would be beneficial because of the reductions in entrainment losses at the south Delta  
 9 facilities across all water-years compared to existing biological conditions. No mitigation would be  
 10 required.

11 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
 12 **Chinook Salmon (Spring-Run ESU)**

13 In general, the effects of Alternative 4 on spawning and egg incubation habitat for spring-run  
 14 Chinook salmon relative to the NAA are uncertain.

15 **H3/ESO**

16 **Sacramento River**

17 There has been a small, inconsistent spawning population (<400 individuals) in the mainstem  
 18 Sacramento River primarily upstream of Red Bluff Diversion Dam over the past decade (Azat 2012).

19 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
 20 salmon spawning and incubation period (September through January) (Appendix 11C, *CALSIM II*  
 21 *Model Results utilized in the Fish Analysis*). Flows under H3 during all months except November  
 22 would generally be similar to those under NAA with few exceptions. Flows under H3 during  
 23 November would be 5% to 18% lower than flows during NAA depending on water year type.

24 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam  
 25 during the spring-run spawning and egg incubation period (September through January). Storage  
 26 under H3 would be similar to (<5% different from) storage under NAA in all water year types (Table  
 27 11-4-27) so there would be no biologically meaningful effects.

28 **Table 11-4-27. Difference and Percent Difference in September Water Storage Volume (thousand**  
 29 **acre-feet) in Shasta Reservoir for Alternative 4 (Scenario H3)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-605 (-18%)	-93 (-3%)
Above Normal	-677 (-21%)	-62 (-2%)
Below Normal	-443 (-15%)	-89 (-4%)
Dry	-535 (-22%)	-24 (-1%)
Critical	-392 (-33%)	-10 (-1%)

30

31 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
 32 examined during the September through January spring-run Chinook salmon spawning period  
 33 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
 34 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water

1 temperature between NAA and H3 in any month or water year type throughout the period at either  
2 location.

3 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
4 determined for each month (May through September At Bend Bridge and October through April at  
5 Red Bluff) and year of the 82-year modeling period (Table 11-4-13). The combination of number of  
6 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
7 Table 11-4-14. Differences between baselines and H3 in the highest level of concern across all  
8 months and all 82 modeled years are presented in Table 11-4-15 for Bend Bridge and in Table 11-4-  
9 28 for Red Bluff. There would be no difference in levels of concern between NAA and H3 at Bend  
10 Bridge. At Red Bluff, there would be 2 (4%) and 3 (23%) more years with a “red” and “orange” level  
11 of concern, respectively, under H3 that would not be biologically meaningful to spring-run Chinook  
12 salmon spawners and eggs, as this is a small proportion of the 82 year period.

13 **Table 11-4-28. Differences between Baseline and H3 Scenarios in the Number of Years in Which**  
14 **Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River**  
15 **at Red Bluff, October through April**

Level of Concern <sup>a</sup>	EXISTING CONDITIONS vs. H3	NAA vs. H3
Red	38 (317%)	2 (4%)
Orange	10 (167%)	3 (23%)
Yellow	-3 (-23%)	-2 (-17%)
None	-45 (-88%)	-3 (-33%)

<sup>a</sup> For definitions of levels of concern, see Table 11-4-14.

16  
17 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
18 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
19 degree-days under H3 would be up to 11% lower than under NAA during May and June and up to  
20 11% higher during July through September (Table 11-4-16). At Red Bluff, total degree-days under  
21 H3 would be 5% higher than those under NAA during October, 7% lower during April, and similar  
22 during remaining months (Table 11-4-29).

1  
2  
3

**Table 11-4-29. Differences between Baseline and H3 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Red Bluff, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
October	Wet	1,262 (491%)	93 (7%)
	Above Normal	514 (198%)	37 (5%)
	Below Normal	798 (382%)	92 (10%)
	Dry	1,164 (237%)	93 (6%)
	Critical	926 (154%)	3 (0%)
	All	4,664 (257%)	318 (5%)
November	Wet	96 (9,600%)	6 (7%)
	Above Normal	67 (NA)	6 (10%)
	Below Normal	52 (NA)	4 (8%)
	Dry	159 (1,988%)	8 (5%)
	Critical	102 (2,550%)	-8 (-7%)
	All	476 (3,662%)	16 (3%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	9 (NA)	0 (0%)
	Above Normal	5 (NA)	1 (25%)
	Below Normal	29 (322%)	8 (27%)
	Dry	64 (457%)	0 (0%)
	Critical	24 (2,400%)	-3 (-11%)
	All	131 (546%)	6 (4%)
April	Wet	260 (226%)	-1 (0%)
	Above Normal	204 (146%)	-25 (-7%)
	Below Normal	229 (290%)	-1 (0%)
	Dry	248 (133%)	-72 (-14%)
	Critical	137 (1,142%)	-14 (-9%)
	All	1,078 (203%)	-113 (-7%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
 2 Sacramento River under H3 would be similar to mortality under NAA in dry and critical years, less in  
 3 dry years, but greater in wet, above normal, and below normal (11% to 29% greater) water years  
 4 (Table 11-4-30). Relative increases of 11% mortality of the spring-run population under wet and  
 5 above normal water years would be negligible to the overall population, particularly because this  
 6 represents a 3% to 4% increase on an absolute scale. However, the 29% relative increase in  
 7 mortality in below normal years would have an effect on the spring-run population. Combining all  
 8 water years, there would be no effect of H3 on egg mortality (3% absolute change).

9 **Table 11-4-30. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**  
 10 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	18 (174%)	3 (11%)
Above Normal	26 (195%)	4 (11%)
Below Normal	41 (349%)	12 (29%)
Dry	54 (275%)	-3 (-3%)
Critical	22 (30%)	0 (0%)
All	32 (141%)	3 (6%)

11  
 12 SacEFT predicts that there would be a 6% relative decrease (3% on an absolute scale) in the  
 13 percentage of years with good spawning availability, measured as weighted usable area, under H3  
 14 relative to NAA (Table 11-4-31). SacEFT predicts that there would be no difference in the  
 15 percentage of years with good (lower) redd scour risk under H3 relative to NAA. SacEFT predicts  
 16 that there would be a 12% decrease on an absolute scale (35% relative decrease) in the percentage  
 17 of years with good (lower) egg incubation conditions under H3 relative to NAA. SacEFT predicts that  
 18 there would be a 6% relative decrease (2% on an absolute scale) in the percentage of years with  
 19 good (lower) redd dewatering risk under H3 relative to NAA.

20 **Table 11-4-31. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
 21 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. H3	NAA vs. H3
Spawning WUA	-24 (-34%)	-3 (-6%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-64 (-74%)	-12 (-35%)
Redd Dewatering Risk	-17 (-35%)	-2 (-6%)
Juvenile Rearing WUA	4 (18%)	4 (18%)
Juvenile Stranding Risk	-7 (-37%)	-2 (-14%)

WUA = Weighted Usable Area.

22  
 23 There is an apparent discrepancy in results of the SacEFT model and Reclamation egg mortality  
 24 model with regard to conditions for spring-run salmon eggs. SacEFT predicts that egg incubation  
 25 habitat would decrease (12% absolute scale decrease) and the Reclamation egg mortality model  
 26 predicts that overall egg mortality would be unaffected by the H3, except in below normal water  
 27 years. The SacEFT uses mid-August through early March as the egg incubation period, based on

1 Vogel and Marine (1991), and the reach between ACID Dam and Battle Creek for redd locations. The  
 2 Reclamation egg mortality model uses the number of days after Julian week 33 (mid-August) that it  
 3 takes to accumulate 750 temperature units to hatching and another 750 temperature units to  
 4 emergence. Temperatures units are calculated by subtracting 32°F from daily river temperature and  
 5 are computed on a daily basis. As a result, egg incubation duration is generally mid-August through  
 6 January, but is dependent on river temperature. The Reclamation model uses the reach between  
 7 ACID Dam and Jelly’s Ferry (approximately 5 river miles downstream of Battle Creek), which  
 8 includes 95% of Sacramento River spawning locations based on 2001–2004 redd survey data  
 9 (Reclamation 2008). These differences in egg incubation period and location likely account for the  
 10 difference between model results. Although the SacEFT model has been peer-reviewed, the  
 11 Reclamation egg mortality model has been extensively reviewed and used in prior biological  
 12 assessments and BiOps. Therefore, both results are considered valid and were considered in  
 13 drawing conclusions about spring-run egg mortality in the Sacramento River.

14 **Clear Creek**

15 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
 16 (September through January) under H3 would generally be similar to flows under NAA throughout  
 17 the spring-run spawning and egg incubation period for all water year types (Appendix 11C, *CALSIM*  
 18 *II Model Results utilized in the Fish Analysis*). The potential risk of spring-run Chinook salmon redd  
 19 dewatering in Clear Creek was evaluated by comparing the magnitude of flow reduction each month  
 20 over the incubation period compared to the flow in September when spawning is assumed to occur.  
 21 The greatest reduction in flows under H3 would be the same as that under NAA in all water year  
 22 types (Table 11-4-32).

23 Water temperatures were not modeled in Clear Creek.

24 **Table 11-4-32. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**  
 25 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**  
 26 **January Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

27

28 **Feather River**

29 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)  
 30 where spring-run Chinook salmon primarily spawn during September through January. Flows under  
 31 H3 would not differ from NAA because minimum Feather River flows are included in the FERC

1 settlement agreement (California Department of Water Resources 2006) and would be met for all  
2 model scenarios (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 Oroville Reservoir storage volume at the end of September influences flows downstream of the dam  
4 during the spring-run spawning and egg incubation period. Storage volume at the end of September  
5 under H3 would be similar to storage under NAA in wet, above normal, and below normal water  
6 years and 18% and 11% greater in dry and critical water years (Table 11-4-33).

7 **Table 11-4-33. Difference and Percent Difference in September Water Storage Volume (thousand**  
8 **acre-feet) in Oroville Reservoir for Alternative 4 (Scenario H3)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-978 (-34%)	36 (2%)
Above Normal	-823 (-35%)	-32 (-2%)
Below Normal	-571 (-28%)	38 (3%)
Dry	-170 (-12%)	183 (18%)
Critical	-100 (-10%)	88 (11%)

9  
10 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
11 comparing the magnitude of flow reduction each month over the egg incubation period compared to  
12 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
13 during October through January were identical between H3 and NAA (Appendix 11C, *CALSIM II*  
14 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of H3 on redd  
15 dewatering in the Feather River low-flow channel.

16 Mean monthly water temperatures in the low-flow channel would not differ between NAA and H3  
17 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
18 *utilized in the Fish Analysis*).

19 Effects of H3 on water temperature-related spawning and egg incubation conditions for spring-run  
20 Chinook salmon in the Feather River were analyzed by comparing the percent of months between  
21 September through January over the 82-year CALSIM modeling period that exceeded a 56°F  
22 temperature threshold in the low-flow channel (above Thermalito Afterbay) (Table 11-4-34). In  
23 general, differences in the percent of months exceeding the threshold between NAA and H3 would  
24 be negligible (<5% on an absolute scale), although there would be a 6% reduction (absolute scale) in  
25 the percent of months exceeding the threshold by >3°F under H3 relative to NAA during October and  
26 in the percent of months exceeding the threshold by >5°F during October and November.

1 **Table 11-4-34. Differences between Baseline and H3 Scenarios in Percent of Months during the 82-**  
 2 **Year CALSIM Modeling Period during Which Water Temperatures in the Feather River above**  
 3 **Thermalito Afterbay Exceed the 56°F Threshold, September through January**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
September	0 (0%)	1 (1%)	7 (8%)	25 (34%)	44 (109%)
October	63 (283%)	59 (800%)	48 (780%)	46 (1,850%)	31 (1,250%)
November	60 (2,450%)	56 (4,500%)	42 (3,400%)	35 (NA)	19 (NA)
December	4 (NA)	2 (NA)	1 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>NAA vs. H3</b>					
September	0 (0%)	0 (0%)	0 (0%)	1 (1%)	2 (3%)
October	-1 (-1%)	1 (2%)	-1 (-2%)	-1 (-3%)	-6 (-16%)
November	-4 (-6%)	-2 (-4%)	-6 (-13%)	2 (8%)	-6 (-25%)
December	0 (0%)	1 (100%)	0 (0%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 The effects of H3 on water temperature-related spawning and egg incubation conditions for spring-

6 run Chinook salmon in the Feather River were also analyzed by comparing the total degree-months

7 for months that exceed the 56°F NMFS threshold during the September through January spring-run

8 Chinook salmon spawning and egg incubation period for all 82 years (Table 11-4-35). Combining all

9 water year types, there would be a small (5% to 7%) reduction in degree-months exceeded under

10 H3 relative to NAA during October and November and no other differences between NAA and H3.

11 Results are highly variable when separating out by water year type, ranging from a 9% more degree-

12 months under H3 in below normal water years during September to a 17% fewer degree-months

13 under H3 in dry water years during October. Overall, there would be many more water year types

14 within months with reductions in exceedances under H3 than increases in exceedances.

1 **Table 11-4-35. Differences between Baseline and H3 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**  
 3 **the Feather River above Thermalito Afterbay, September through January**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
September	Wet	30 (28%)	5 (4%)
	Above Normal	14 (33%)	4 (8%)
	Below Normal	39 (65%)	8 (9%)
	Dry	71 (103%)	-17 (-11%)
	Critical	54 (83%)	-8 (-6%)
	All	208 (60%)	-8 (-1%)
October	Wet	79 (1,580%)	-17 (-17%)
	Above Normal	30 (300%)	-5 (-11%)
	Below Normal	50 (714%)	-4 (-7%)
	Dry	81 (1,157%)	1 (1%)
	Critical	41 (513%)	0 (0%)
	All	281 (759%)	-25 (-7%)
November	Wet	57 (NA)	1 (2%)
	Above Normal	23 (767%)	-2 (-7%)
	Below Normal	32 (3,200%)	-2 (-6%)
	Dry	46 (NA)	-5 (-10%)
	Critical	26 (NA)	-2 (-7%)
	All	184 (4,600%)	-10 (-5%)
December	Wet	1 (NA)	0 (0%)
	Above Normal	2 (NA)	1 (100%)
	Below Normal	3 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	6 (NA)	1 (20%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 **H1/LOS**

6

**Sacramento River**

7

Flows in the Sacramento River between Keswick and upstream of RBDD under H1 during the  
 8 September through January spring-run Chinook salmon spawning and egg incubation period would  
 9 generally be up to 23% greater than flows under H3 during January, similar to flows under H3  
 10 during September, October, and December, and up to 16% lower during November depending on  
 11 water year type. However, these increases and reductions in flows would be too infrequent or of too  
 12 low a magnitude to have a biologically meaningful effect on spring-run Chinook salmon spawning

1 and egg incubation habitat. Shasta Reservoir storage at the end of September under H1 would be  
2 similar to storage under H3 (Table 11-4-36).

3 **Table 11-4-36. Difference and Percent Difference in September Water Storage Volume (thousand**  
4 **acre-feet) in Shasta Reservoir for H1, H3, and H4 Scenarios**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	331 (12.2%)	10 (0.4%)
Above Normal	170 (6.8%)	43 (1.7%)
Below Normal	-11 (-0.4%)	125 (5.2%)
Dry	74 (3.8%)	71 (3.7%)
Critical	10 (1.3%)	55 (6.9%)

5  
6 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
7 examined during the September through January spring-run Chinook salmon spawning period  
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
9 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
10 temperature between NAA and H1 in any month or water year type throughout the period at either  
11 location.

12 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
13 determined for each month (May through September at Bend Bridge and October through April at  
14 Red Bluff) and year of the 82-year modeling period (Table 11-4-13). The combination of number of  
15 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
16 Table 11-4-14. Differences between baselines and H1 in the highest level of concern across all  
17 months and all 82 modeled years are presented in Table 11-4-20 for Bend Bridge and in Table 11-4-  
18 37 for Red Bluff. There would be no difference in levels of concern between NAA and H1 at Bend  
19 Bridge. At Red Bluff, there would be 6 (13%) fewer years with a “red” level of concern.

20 **Table 11-4-37. Differences between Baseline and H3 Scenarios in the Number of Years in Which**  
21 **Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River**  
22 **at Red Bluff, October through April**

Level of Concern <sup>a</sup>	EXISTING		EXISTING	
	CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
Red	30 (250%)	-6 (-13%)	38 (317%)	2 (4%)
Orange	15 (250%)	8 (62%)	9 (150%)	2 (15%)
Yellow	-2 (-15%)	-1 (-8%)	-5 (-38%)	-4 (-33%)
None	-43 (-84%)	-1 (-11%)	-42 (-82%)	0 (0%)

<sup>a</sup> For definitions of levels of concern, see Table 11-4-14.

23  
24 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
25 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
26 degree-days under H1 would be up to 11% to 12% lower than under NAA during May and June and  
27 8% to 16% higher during July through September (Table 11-4-21). At Red Bluff, total degree-days  
28 under H1 would be 10% lower than those under H1 during November, 5% higher during March, and  
29 similar during remaining months (Table 11-4-38).

1 **Table 11-4-38. Differences between Baseline and H3 Scenarios in Total Degree-Days (°F-Days) by**  
 2 **Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River**  
 3 **at Red Bluff, October through April**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
October	Wet	1,084 (422%)	-85 (-6%)	1,261 (491%)	92 (6%)
	Above Normal	452 (174%)	-25 (-3%)	498 (192%)	21 (3%)
	Below Normal	685 (328%)	-21 (-2%)	697 (333%)	-9 (-1%)
	Dry	1,018 (207%)	-53 (-3%)	1,044 (213%)	-27 (-2%)
	Critical	859 (143%)	-64 (-4%)	827 (138%)	-96 (-6%)
	All	4,098 (226%)	-248 (-4%)	4,327 (238%)	-19 (-0.3%)
November	Wet	72 (7,200%)	-18 (-20%)	94 (9,400%)	4 (4%)
	Above Normal	64 (NA)	3 (5%)	71 (NA)	10 (16%)
	Below Normal	41 (NA)	-7 (-15%)	45 (NA)	-3 (-6%)
	Dry	139 (1,738%)	-12 (-8%)	145 (1,813%)	-6 (-4%)
	Critical	98 (2,450%)	-12 (-11%)	88 (2,200%)	-22 (-19%)
	All	414 (3,185%)	-46 (-10%)	443 (3,408%)	-17 (-4%)
December	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	Wet	9 (NA)	0 (0%)	9 (NA)	0 (0%)
	Above Normal	6 (NA)	2 (50%)	5 (NA)	1 (25%)
	Below Normal	29 (322%)	8 (27%)	35 (389%)	14 (47%)
	Dry	63 (450%)	-1 (-1%)	65 (464%)	1 (1%)
	Critical	25 (2,500%)	-2 (-7%)	26 (2,600%)	-1 (-4%)
	All	132 (550%)	7 (5%)	140 (583%)	15 (10%)
April	Wet	259 (225%)	-2 (-1%)	262 (228%)	1 (0%)
	Above Normal	202 (144%)	-27 (-7%)	205 (146%)	-24 (-7%)
	Below Normal	230 (291%)	0 (0%)	255 (323%)	25 (8%)
	Dry	294 (158%)	-26 (-5%)	322 (173%)	2 (0%)
	Critical	135 (1,125%)	-16 (-10%)	131 (1,092%)	-20 (-12%)
	All	1,120 (211%)	-71 (-4%)	1,175 (221%)	-16 (-1%)

NA = could not be calculated because the denominator was 0.

1 **Clear Creek**

2 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
3 (September through January) under H1 would generally be similar to those under H3 (Appendix  
4 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because flows would generally be similar  
5 between H1 and H3, results of the redd dewatering analysis would be similar between H1 and H3.  
6 Therefore, no analysis of redd dewatering risk was conducted for H1 in Clear Creek. Due to similar  
7 flows between H1 and H3, effects of H1 on spring-run Chinook salmon spawning and egg incubation  
8 habitat in Clear Creek would not be different from effects of H3.

9 **Feather River**

10 H1 flows in the Feather River low-flow channel during the spring-run Chinook salmon spawning and  
11 egg incubation period (September through January) would be similar between H1 and H3 (Appendix  
12 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Oroville Reservoir storage volume at the  
13 end of September under H1 would generally be similar to or greater than storage under H3  
14 depending on water year type (Table 11-4-39). Higher storage during wetter water year types  
15 would generally benefit spring-run Chinook spawning and egg incubation habitat.

16 **Table 11-4-39. Difference and Percent Difference in September Water Storage Volume (thousand**  
17 **acre-feet) in Oroville Reservoir for H1, H3, and H4 Scenarios**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	388 (20.2%)	19 (1%)
Above Normal	178 (11.5%)	82 (5.3%)
Below Normal	81 (5.6%)	-48 (-3.3%)
Dry	62 (5.2%)	137 (11.5%)
Critical	50 (5.6%)	207 (23.4%)

18

19 Mean monthly water temperatures in the low-flow channel would not differ between NAA and H1  
20 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
21 *utilized in the Fish Analysis*).

22 Differences in the percent of months exceeding the 56°F threshold between NAA and H1 would  
23 generally be negligible (<5% on an absolute scale) except during October and November, during  
24 which the exceedances would be between 17% and 26% (absolute scale) lower under H1 (Table 11-  
25 4-40). This represents a moderate benefit of H1 on spring-run spawning habitat conditions in the  
26 Feather River.

1 **Table 11-4-40. Differences between Baselines and H1 and H4 Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River above Thermalito Afterbay Exceed the 56°F Threshold, September through January**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
September	0 (0%)	1 (1%)	9 (9%)	21 (29%)	46 (112%)
October	40 (178%)	37 (500%)	31 (500%)	28 (1,150%)	20 (800%)
November	41 (1,650%)	35 (2,800%)	22 (1,800%)	11 (NA)	7 (NA)
December	2 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>NAA vs. H1</b>					
September	0 (0%)	0 (0%)	1 (1%)	-2 (-3%)	4 (4%)
October	-25 (-29%)	-21 (-32%)	-19 (-33%)	-19 (-38%)	-17 (-44%)
November	-23 (-35%)	-23 (-40%)	-26 (-53%)	-21 (-65%)	-17 (-70%)
December	-1 (-33%)	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>EXISTING CONDITIONS vs. H4</b>					
September	0 (0%)	0 (0%)	6 (7%)	19 (25%)	40 (97%)
October	46 (206%)	49 (667%)	41 (660%)	37 (1,500%)	36 (1,450%)
November	46 (1,850%)	41 (3,300%)	30 (2,400%)	22 (NA)	15 (NA)
December	2 (NA)	1 (NA)	1 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>NAA vs. H4</b>					
September	0 (0%)	-1 (-1%)	-1 (-1%)	-5 (-5%)	-2 (-3%)
October	-19 (-21%)	-9 (-13%)	-9 (-16%)	-10 (-20%)	-1 (-3%)
November	-19 (-28%)	-17 (-29%)	-19 (-38%)	-10 (-31%)	-10 (-40%)
December	-1 (-33%)	0 (0%)	0 (0%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4  
 5 During September, exceedances above the 56°F threshold under H1 would not differ from those  
 6 under NAA across all water years (Table 11-4-41). Total degree-months above the 56°F threshold  
 7 under H1 would be higher than those under NAA in wetter water years and lower in drier water  
 8 year types. During October and November, exceedances above the threshold under H1 would be 76  
 9 to 112 (33% to 38%) fewer degree-months than exceedances under NAA. There would be no  
 10 meaningful differences between NAA and H1 during December and January.

1 **Table 11-4-41. Differences between Baseline Scenarios and H1 and H4 Scenarios in Total Degree-**  
 2 **Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F**  
 3 **in the Feather River above Thermalito Afterbay, September through April**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
September	Wet	59 (55%)	34 (26%)	56 (52%)	31 (23%)
	Above Normal	23 (53%)	13 (25%)	32 (74%)	22 (42%)
	Below Normal	37 (62%)	6 (7%)	69 (115%)	38 (42%)
	Dry	53 (77%)	-35 (-22%)	50 (72%)	-38 (-24%)
	Critical	44 (68%)	-18 (-14%)	25 (38%)	-37 (-29%)
	All	216 (63%)	0 (0%)	232 (67%)	16 (3%)
October	Wet	46 (920%)	-50 (-50%)	98 (1,960%)	2 (2%)
	Above Normal	25 (250%)	-10 (-22%)	52 (520%)	17 (38%)
	Below Normal	41 (586%)	-13 (-21%)	62 (886%)	8 (13%)
	Dry	52 (743%)	-28 (-32%)	77 (1,100%)	-3 (-3%)
	Critical	31 (388%)	-10 (-20%)	14 (175%)	-27 (-55%)
	All	194 (524%)	-112 (-33%)	303 (819%)	-3 (-1%)
November	Wet	28 (NA)	-28 (-50%)	47 (NA)	-9 (-16%)
	Above Normal	18 (600%)	-7 (-25%)	30 (1,000%)	5 (18%)
	Below Normal	18 (1,800%)	-16 (-46%)	28 (2,800%)	-6 (-17%)
	Dry	32 (NA)	-19 (-37%)	41 (NA)	-10 (-20%)
	Critical	23 (NA)	-5 (-18%)	9 (NA)	-19 (-68%)
	All	118 (2,950%)	-76 (-38%)	155 (3,875%)	-39 (-20%)
December	Wet	0 (NA)	-1 (-100%)	0 (NA)	-1 (-100%)
	Above Normal	1 (NA)	0 (0%)	1 (NA)	0 (0%)
	Below Normal	1 (NA)	-2 (-67%)	3 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	1 (NA)	1 (NA)	1 (NA)	1 (NA)
	All	3 (NA)	-2 (-40%)	5 (NA)	0 (0%)
January	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 Due to generally similar flows, reservoir storage, and water temperatures between H1 and H3,  
 6 effects of H1 on spring-run Chinook salmon spawning and egg incubation habitat in the Feather  
 7 River would generally not be different from effects of H3, except for beneficial effects of reservoir  
 8 storage under H1 in wetter water year types and in the percent of months and total degree-months  
 9 exceeding the 56°F threshold.

1 **H4/HOS**

2 ***Sacramento River***

3 Flows in the Sacramento River between Keswick and upstream of RBDD under H4 during the  
4 September through January spring-run Chinook salmon spawning and egg incubation period would  
5 generally be similar to flows under H3. Shasta Reservoir storage at the end of September under H4  
6 would be similar to storage under H3 (Table 11-4-27).

7 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
8 determined for each month (May through September at Bend Bridge and October through April at  
9 Red Bluff) and year of the 82-year modeling period (Table 11-4-13). The combination of number of  
10 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
11 Table 11-4-14. Differences between baselines and H4 in the highest level of concern across all  
12 months and all 82 modeled years are presented in Table 11-4-20 for Bend Bridge and in Table 11-4-  
13 37 for Red Bluff. There would be no difference in levels of concern between NAA and H4 at Bend  
14 Bridge or at Red Bluff.

15 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
16 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
17 degree-days under H4 would be up to 5% lower than under NAA during August and similar during  
18 other months (Table 11-4-21). At Red Bluff, exceedances above the threshold under H4 would be 15  
19 degree-days (10%) higher than those under Existing Conditions during March, and similar during  
20 remaining months (Table 11-4-38). On an absolute scale, the 15 degree-day increase during March,  
21 because it is the sum of the 82-year period, would not translate into a biologically meaningful effect  
22 on spring-run Chinook salmon.

23 ***Clear Creek***

24 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
25 (September through January) under H4 would generally be similar to those under H3 (Appendix  
26 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because flows would generally be similar  
27 between H4 and H3, results of the redd dewatering analysis would be similar between H4 and H3.  
28 Therefore, no analysis of redd dewatering risk was conducted for H4 in Clear Creek. Due to similar  
29 flows between H4 and H3, effects of H4 on spring-run Chinook salmon spawning and egg incubation  
30 habitat in Clear Creek would not be different from effects of H3.

31 ***Feather River***

32 Flows in the Feather River low-flow channel during the spring-run Chinook salmon spawning and  
33 egg incubation period (September through January) would be similar between H4 and H3 (Appendix  
34 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Oroville Reservoir storage volume at the  
35 end of September under H4 would generally be similar to or greater than storage under H3  
36 depending on water year type (Table 11-4-39). Higher storage in drier water year types would  
37 generally benefit spring-run Chinook salmon spawning and rearing habitat. Mean monthly water  
38 temperatures in the low-flow channel would not differ between NAA and H4 (Appendix 11D,  
39 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
40 *Fish Analysis*).

1 Differences in the percent of months exceeding the threshold between NAA and H4 would generally  
2 be negligible (<5% on an absolute scale) during all months except November, in which there would  
3 be up to 19% fewer months exceeding the threshold under H4 (Table 11-4-40).

4 Total degree-days of exceedance above the 56°F threshold under H4 would be similar to those  
5 under NAA in all months of the period except November, in which the total would be 20% lower.  
6 However, a reduction of 39 degree-days would not be biologically meaningful for the 82-year period.

7 Due to generally similar flows, reservoir storage, and water temperatures between H4 and H3,  
8 effects of H4 on spring-run Chinook salmon spawning and egg incubation habitat in the Feather  
9 River would generally not be different from effects of H3, except for beneficial effects of reservoir  
10 storage under H4 in drier water year types.

11 **NEPA Effects:** Alternative 4 does not propose any changes in Shasta Reservoir operating criteria,  
12 and CALSIM results show that Reclamation could operate Shasta in such a manner that it does not  
13 affect upstream storage or flows substantially as compared to the NAA. Available analytical tools  
14 show conflicting results regarding the temperature effects of relatively small changes in predicted  
15 summer and fall flows. Several models (CALSIM, SRWQM, and Reclamation Egg Mortality Model)  
16 generally show no change in upstream conditions as a result of Alternative 4. However, one model,  
17 SacEFT, shows adverse effects under some conditions. After extensive investigation of these results,  
18 they appear to be a function of high model sensitivity to relatively small changes in estimated  
19 upstream conditions, which may or may not accurately predict adverse effects. Temperature and  
20 end of September storage criteria from the NMFS (2009a) BiOp for Shasta reservoir are maintained,  
21 in order to minimize adverse effects to spawning and incubating salmonids including spring-run  
22 Chinook salmon. However, the new NDD structures allow for spring time deliveries of water south of  
23 the Delta that are currently constrained under the NAA. For this reason, additional spring storage  
24 criteria may be necessary to ensure Shasta operations similar to what was modeled. These  
25 discussions will occur in the Section 7 consultation with Reclamation on Shasta and system-wide  
26 operations, which is outside the scope of BDCP. In conclusion, Alternative 4 modeling results  
27 support a finding that effects are uncertain. Alternative 4 does not propose any changes to Shasta  
28 operating criteria, but modeled results are mixed and operations that match the CALSIM modeling  
29 are not assured. Model results will be submitted to independent peer review to confirm that adverse  
30 effects are not reasonably anticipated to occur.

31 Considering that Alternative 4 modeling results do not predict significant adverse changes in  
32 Feather River flows or temperatures (in the low-flow channel) during the spring-run spawning or  
33 incubation period, it is not expected that Alternative 4 will result in an adverse effect on spring-run  
34 Chinook salmon spawning and egg incubation habitat in the Feather River. Because the High  
35 Outflow Scenario of Alternative 4 (Scenario H3) results in changes to Oroville reservoir releases in  
36 some springs and summers, which, in turn, could affect the cold water pool and fall temperatures in  
37 the low-flow channel, temperature and biological modeling results will be submitted to independent  
38 peer review to confirm that adverse effects are not reasonably anticipated to occur.

39 **CEQA Conclusion:** In general, Alternative 4 would not affect the quantity and quality of spawning  
40 and egg incubation habitat for spring-run Chinook salmon relative to Existing Conditions.

1 **H3/ESO**

2 ***Sacramento River***

3 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
4 examined during the September through January spring-run Chinook salmon spawning period  
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
6 *utilized in the Fish Analysis*). At Keswick, temperatures under H3 during September and October  
7 would both be 6% greater, respectively, than those under Existing Conditions, but not different in  
8 other months during the period. At Red Bluff, temperatures under H3 during September and  
9 October would be 5% and 6% greater, respectively, than those under Existing Conditions, but not  
10 different in other months during the period.

11 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
12 determined for each month (May through September At Bend Bridge and October through April at  
13 Red Bluff) and year of the 82-year modeling period (Table 11-4-13). The combination of number of  
14 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
15 Table 11-4-14. Differences between baselines and H3 in the highest level of concern across all  
16 months and all 82 modeled years are presented in Table 11-4-15 for Bend Bridge and in Table 11-4-  
17 28 for Red Bluff. At Bend Bridge, there would be a 61% increase in the number of years with a “red”  
18 level of concern under H3 relative to Existing Conditions. At Red Bluff, there would be 317% and  
19 167% increases in the number of years with “red” and “orange” levels of concern under H3 relative  
20 to Existing Conditions.

21 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
22 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
23 degree-days under H3 would be 132% to 273% higher than that under Existing Conditions  
24 depending on month throughout the period (Table 11-4-16). At Red Bluff, total degree-days under  
25 H3 would be 203% to 3,662% higher than those under Existing Conditions during October,  
26 November, March, and April, and similar during December through February (Table 11-4-29).

27 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook  
28 salmon spawning and incubation period (September through January). Flows under H3 during all  
29 months but November would generally be similar to flows under Existing Conditions with few  
30 exceptions. Flows under H3 during November would be 9% to 14% lower than flows under NAA  
31 depending on water year type.

32 Shasta Reservoir Storage volume at the end of September would be 15% to 33% lower under H3  
33 relative to Existing Conditions (Table 11-4-27).

34 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the  
35 Sacramento River under H3 would be 30% to 349% greater than mortality under Existing  
36 Conditions depending on water year type (Table 11-4-30).

37 SacEFT predicts that there would be a 34% decrease in the percentage of years with good spawning  
38 availability, measured as weighted usable area, under H3 relative to Existing Conditions (Table 11-  
39 4-31). SacEFT predicts that there would be no difference in the percentage of years with good  
40 (lower) redd scour risk under H3 relative to Existing Conditions. SacEFT predicts that there would  
41 be a 74% decrease in the percentage of years with good (lower) egg incubation conditions under H3  
42 relative to Existing Conditions. SacEFT predicts that there would be a 35% decrease in the  
43 percentage of years with good (lower) redd dewatering risk under H3 relative to Existing

1 Conditions. These results indicate that spawning and egg incubation conditions for spring-run  
2 Chinook salmon under H3 would be substantially lower relative to Existing Conditions.

### 3 **Clear Creek**

4 Flows in Clear Creek were examined during the spring-run Chinook salmon spawning and egg  
5 incubation period (September through January). Flows under H3 would generally be similar to flows  
6 under Existing Conditions with few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the*  
7 *Fish Analysis*).

8 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by  
9 comparing the magnitude of flow reduction each month over the incubation period compared to the  
10 flow in September when spawning is assumed to occur. The greatest reduction in flows under H3  
11 would be similar to or lower magnitude than that under Existing Conditions in wet and below  
12 normal water years (Table 11-4-32). The greatest reduction in flows under H3 would be 27 cfs to  
13 67cfs lower (worse) than Existing Conditions in above normal, dry, and critical years.

14 Water temperatures were not modeled in Clear Creek.

### 15 **Feather River**

16 Flows in the Feather River low-flow channel under H3 are not different from Existing Conditions  
17 during the September through January spring-run spawning and egg incubation period (Appendix  
18 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January(800 cfs)  
19 would be equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

20 Oroville Reservoir storage volume at the end of September would be 10% to 35% lower under H3  
21 relative to Existing Conditions depending on water year type (Table 11-4-33).

22 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
23 comparing the magnitude of flow reduction each month over the incubation period compared to the  
24 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel  
25 during October through January were identical between H3 and Existing Conditions (Appendix 11C,  
26 *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of H3 on  
27 redd dewatering in the Feather River low-flow channel.

28 Mean monthly water temperatures in the low-flow channel under H3 would be up to 10% higher  
29 under H3 relative to Existing Conditions during the September through January spawning and egg  
30 incubation period(Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
31 *Temperature Model Results utilized in the Fish Analysis*).

32 Effects of H3 on water temperature in the Feather River were analyzed by determining the percent  
33 of months between September and October over the 82-year CALSIM modeling period that exceed a  
34 56°F temperature threshold in the low-flow channel (above Thermalito Afterbay) (Table 11-4-34).  
35 In general, the percent of months exceeding the threshold under H3 would be similar to or greater  
36 by up to 63% (absolute scale) than the percent under Existing Conditions. This comparison includes  
37 the effects of climate change.

38 The effects of H3 on water temperature in the Feather River were also analyzed by comparing the  
39 total degree-months for months that exceed the 56°F NMFS threshold during the September and  
40 October spring-run Chinook salmon spawning period for all 82 years (Table 11-4-35). Total degree-

1 months would be 60% to 4,600% higher under H3 relative to Existing Conditions regardless of  
2 month or water year type. This comparison includes the effects of climate change.

### 3 **H1/LOS**

#### 4 ***Sacramento River***

5 Flows in the Sacramento River between Keswick and upstream of RBDD under H1 during the  
6 September through January spring-run Chinook salmon spawning and egg incubation period would  
7 generally be up to 23% greater than flows under H3 during January, similar to flows under H3  
8 during September, October, and December, and up to 16% lower during November depending on  
9 water year type. However, these increases and reductions in flows would be too infrequent or too  
10 low of magnitude to have a biologically meaningful effect on spring-run Chinook salmon spawning  
11 and egg incubation habitat. Shasta Reservoir storage at the end of September under H1 would be  
12 similar to storage under H3 (Table 11-4-27).

13 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
14 examined during the September through January spring-run Chinook salmon spawning period  
15 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
16 *utilized in the Fish Analysis*). At both Keswick and Red Bluff, temperatures under H1 during  
17 September and October would be 5% and 6% greater, respectively, than those under Existing  
18 Conditions, but not different in other months during the period.

19 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was  
20 determined for each month (May through September At Bend Bridge and October through April at  
21 Red Bluff) and year of the 82-year modeling period (Table 11-4-13). The combination of number of  
22 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in  
23 Table 11-4-14. Differences between baselines and H1 and H4 scenarios in the highest level of  
24 concern across all months and all 82 modeled years are presented in Table 11-4-20 for Bend Bridge  
25 and in Table 11-4-37 for Red Bluff. At Bend Bridge, there would be a 61% increase in the number of  
26 years with a “red” level of concern under H1 relative to Existing Conditions. At Red Bluff, there  
27 would be 250% increases in the number of years with “red” and “orange” levels of concern under H1  
28 relative to Existing Conditions.

29 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge  
30 during May through September and at Red Bluff during October through April. At Bend Bridge, total  
31 degree-days under H1 would be 153% to 255% higher than that under Existing Conditions  
32 depending on month throughout the period (Table 11-4-21). At Red Bluff, total degree-days under  
33 H1 would be 211% to 3,185% higher than those under Existing Conditions during October,  
34 November, March, and April, and similar during December through February (Table 11-4-38).

35 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
36 additional analyses (e.g., egg mortality model, SacEFT) under H1 would be similar to results for  
37 analyses under H3. As a result, these additional analyses were not conducted for H1. Overall,  
38 conclusions for H1 would be similar to those for H3.

#### 39 ***Clear Creek***

40 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
41 (September through January) under H1 would generally be similar to those under H3 (Appendix  
42 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because flows would generally be similar

1 between H1 and H3, results of the redd dewatering analysis would be similar between H1 and H3.  
2 Therefore, no analysis of redd dewatering risk was conducted for H1 in Clear Creek. Due to similar  
3 flows between H1 and H3, effects of H1 on spring-run Chinook salmon spawning and egg incubation  
4 habitat in Clear Creek would not be different from effects of H3.

#### 5 **Feather River**

6 Flows in the Feather River low-flow channel during the spring-run Chinook salmon spawning and  
7 egg incubation period (September through January) would be similar between H1 and H3 (Appendix  
8 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Oroville Reservoir storage volume at the  
9 end of September under H1 would generally be similar to or greater than storage under H3  
10 depending on water year type (Table 11-4-39). Higher storage during wetter water year types  
11 would generally benefit spring-run Chinook spawning and egg incubation habitat. Mean monthly  
12 water temperatures in the low-flow channel would be up to 9% higher under H1 relative to Existing  
13 Conditions during the September through January spawning and egg incubation period (Appendix  
14 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
15 *the Fish Analysis*).

16 The percent of months exceeding the 56°F NMFS temperature threshold under H1 would be similar  
17 to or greater by up to 46% (absolute scale) than the percent under Existing Conditions during  
18 September through November, but similar during December and January (Table 11-4-40). This  
19 comparison includes the effects of climate change.

20 Total degree-months exceeding the 56°F NMFS threshold under H1 would be 63% to 2,950% higher  
21 relative to Existing Conditions regardless of month or water year type during September through  
22 November, but similar during December and January (Table 11-4-41). This comparison includes the  
23 effects of climate change.

24 Due to generally similar flows, reservoir storage, and water temperatures between H1 and H3,  
25 effects of H1 on spring-run Chinook salmon spawning and egg incubation habitat in the Feather  
26 River would generally not be different from effects of H3, except for beneficial effects of reservoir  
27 storage under H1 in wetter water year types.

#### 28 **H4/HOS**

#### 29 **Sacramento River**

30 Water temperatures in the Sacramento River under H4 would not differ from those under H3  
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the Sacramento River  
32 between Keswick and upstream of RBDD under H4 during the September through January spring-  
33 run Chinook salmon spawning and egg incubation period would generally be similar to flows under  
34 H3. Shasta Reservoir storage at the end of September under H4 would be similar to storage under  
35 H3 (Table 11-4-27).

36 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
37 additional analyses (e.g., egg mortality model, SacEFT) under H4 would be similar to results for  
38 analyses under H3. As a result, these additional analyses were not conducted for H4. Overall, effects  
39 of H4 on spring-run Chinook salmon spawning and egg incubation habitat in the Sacramento River  
40 would not be different from effects of H3.

1 **Clear Creek**

2 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period  
3 (September through January) under H4 would generally be similar to those under H3 (Appendix  
4 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because flows would generally be similar  
5 between H4 and H3, results of the redd dewatering analysis would be similar between H4 and H3.  
6 Therefore, no analysis of redd dewatering risk was conducted for H4 in Clear Creek. Due to similar  
7 flows between H4 and H3, effects of H4 on spring-run Chinook salmon spawning and egg incubation  
8 habitat in Clear Creek would not be different from effects of H3.

9 **Feather River**

10 Flows in the Feather River low-flow channel during the spring-run Chinook salmon spawning and  
11 egg incubation period (September through October) would be similar between H4 and H3  
12 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Oroville Reservoir storage  
13 volume at the end of September under H4 would generally be similar to or greater than storage  
14 under H3 depending on water year type (Table 11-4-33). Higher storage in drier water year types  
15 would generally benefit spring-run Chinook salmon spawning and rearing habitat. Mean monthly  
16 water temperatures in the low-flow channel would be up to 9% higher under H4 relative to Existing  
17 Conditions during the September through January spawning and egg incubation period (Appendix  
18 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
19 *the Fish Analysis*).

20 There would be an increased percent of months (up to 49% on an absolute scale) under H4 above  
21 the 56°F threshold compared to Existing Conditions during September through November and no  
22 change in December and January (Table 11-4-40).

23 The number of degree-months exceeding the threshold under H4 would be 67% to 3,875% higher  
24 than the number under Existing Conditions during September through November, but no there  
25 would be no differences during December and January (Table 11-4-41).

26 Due to generally similar flows, reservoir storage, and water temperatures between H4 and H3,  
27 effects of H4 on spring-run Chinook salmon spawning and egg incubation habitat in the Feather  
28 River would generally not be different from effects of H3, except for beneficial effects of reservoir  
29 storage under H4 in drier water year types.

30 **Summary of CEQA Conclusion**

31 Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between  
32 the CEQA baseline and Alternative 4 could be significant because, when compared to the CEQA  
33 baseline, the alternative could substantially reduce suitable spawning habitat and substantially  
34 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth  
35 above, which is directly related to the inclusion of climate change effects in Alternative 4.

36 There are biologically meaningful flow reductions and temperature increases in the Sacramento  
37 River that would lead to increased egg mortality and overall reduced habitat conditions in spring-  
38 run spawning and egg incubation habitat conditions. Flows in the Feather River low-flow channel do  
39 not differ between Alternative 4 and Existing Conditions. However, water temperature analyses in  
40 the Feather River low-flow channel using the NMFS thresholds indicate that there would be  
41 moderate to large negative effects on temperature conditions during spring-run Chinook salmon  
42 spawning and egg incubation.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow and reservoir storage outputs between Existing  
13 Conditions in the late long-term implementation period and H3 indicates that flows and reservoir  
14 storage in the locations and during the months analyzed above would generally be similar between  
15 future conditions without the BDCP (NAA) and H3. This indicates that the differences between  
16 Existing Conditions and Alternative 4 found above would generally be due to climate change, sea  
17 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding  
18 Alternative 4, if adjusted to exclude sea level rise and climate change, is similar to the NEPA  
19 conclusion, and therefore would not in itself result in a significant impact on spawning and egg  
20 incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant  
21 and no mitigation is required.

## 22 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring- 23 Run ESU)**

24 In general, Alternative 4 would not affect the quantity and quality of rearing habitat for fry and  
25 juvenile spring-run Chinook salmon relative to the NAA.

## 26 **H3/ESO**

### 27 ***Sacramento River***

28 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
29 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
30 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Keswick, flows under  
31 H3 would generally be up to 23% lower during November than under NAA and similar in the  
32 remaining months. Upstream of Red Bluff, flows under H3 would generally be up to 18% lower  
33 during November than under NAA and similar in the remaining months. These results indicate that  
34 there would very few reductions in flows due to H3 in the Sacramento River.

35 As reported in Impact AQUA-40, May Shasta storage volume under H3 would be similar to or greater  
36 than storage under NAA for all water year types (Table 11-4-12) so there would be no biologically  
37 meaningful effects on downstream flows.

38 As reported in Impact AQUA-58, September Shasta storage volume under H3 would be similar to  
39 (<5% difference from) storage under NAA in all water year types (Table 11-4-27).

40 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
41 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
2 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
3 NAA and H3 in any month or water year type throughout the period at either location.

4 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under H3  
5 would be 18% greater than that under NAA (Table 11-4-31). However, the percentage of years with  
6 good (lower) juvenile stranding risk conditions under H3 would be 14% lower than under NAA. On  
7 an absolute scale, juvenile stranding risk would decrease in only 2% of years. This reduction would  
8 not have a biologically meaningful effect on spring-run Chinook salmon.

9 SALMOD predicts that spring-run smolt equivalent habitat-related mortality would be similar to  
10 (<5% different from) NAA.

11 **Clear Creek**

12 Flows in Clear Creek during the November through March rearing period under H3 would generally  
13 be similar to flows under NAA with few exceptions (Appendix 11C, *CALSIM II Model Results utilized*  
14 *in the Fish Analysis*).

15 Water temperatures were not modeled in Clear Creek.

16 **Feather River**

17 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
18 channel) during November through June were reviewed to determine flow-related effects on larval  
19 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
20 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under H3 would  
21 not differ from those under NAA. In the high-flow channel, flows under H3 would generally be lower  
22 by up to 50% (monthly mean of up to 19% lower) than flows under NAA during July through  
23 September, generally greater by up to 79% (monthly mean of up to 48% higher) during February  
24 through June, and similar during January and October through December.

25 May Oroville storage volume under H3 would be similar to storage under NAA in all water year  
26 types (Table 11-4-42).

27 As reported in Impact AQUA-58, September Oroville storage volume under H3 would be similar to  
28 volume under NAA in wet, above normal, and below normal water years and 11% to 18% greater  
29 than volume under NAA during dry and critical water years (Table 11-4-33). Consequently, there  
30 would be minimal effects on downstream flows.

31 **Table 11-4-42. Difference and Percent Difference in May Water Storage Volume (thousand**  
32 **acre-feet) in Oroville Reservoir for Alternative 4 (Model Scenario H3)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-67 (-2%)	-21 (-1%)
Above Normal	-192 (-5%)	-36 (-1%)
Below Normal	-362 (-11%)	-9 (0%)
Dry	-532 (-19%)	-12 (-1%)
Critical	-372 (-20%)	-56 (-4%)

33

1 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
2 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
3 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
4 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
5 between NAA and H3 in any month or water year type throughout the period at either location.

6 The percent of months exceeding the 63°F temperature threshold in the Feather River above  
7 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-4-43).  
8 In general, differences in the percent of months exceeding the threshold between NAA and H3 would  
9 be negligible (<5% on an absolute scale), although there are some small (up to 9% on an absolute  
10 scale) increases and decreases in percent of months exceeding the threshold during June and August  
11 depending on the degrees above the threshold.

12 **Table 11-4-43. Differences between Baseline and H3 Scenarios in Percent of Months during the**  
13 **82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River above**  
14 **Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
May	6 (NA)	2 (NA)	1 (NA)	0 (NA)	0 (NA)
June	31 (56%)	46 (168%)	38 (775%)	17 (NA)	5 (NA)
July	0 (0%)	0 (0%)	1 (1%)	27 (37%)	53 (134%)
August	0 (0%)	12 (14%)	41 (70%)	59 (209%)	56 (563%)
<b>NAA vs. H3</b>					
May	0 (0%)	0 (0%)	0 (0%)	0 (NA)	0 (NA)
June	-2 (-3%)	-5 (-6%)	-4 (-8%)	-4 (-18%)	0 (0%)
July	0 (0%)	0 (0%)	0 (0%)	1 (1%)	-1 (-1%)
August	0 (0%)	0 (0%)	0 (0%)	6 (8%)	9 (15%)

NA = could not be calculated because the denominator was 0.

15  
16 The effects of H3 on water temperature-related juvenile rearing conditions for spring-run Chinook  
17 salmon in the Feather River were also analyzed by comparing the total degree-months for months  
18 that exceed the 56°F NMFS threshold during May through August for all 82 years (Table 11-4-44).  
19 Combining all water year types, there would be no difference in total degree-months exceeded  
20 between NAA and H3 except during June (6% lower). There would be no differences in exceedances  
21 during May and July, but small increases and decreases (up to 13%) in degree-months within June  
22 and August depending on water year type.

1 **Table 11-4-44. Differences between Baseline and H3 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in**  
 3 **the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
May	Wet	1 (NA)	0 (0%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	4 (NA)	0 (0%)
	All	8 (NA)	0 (0%)
June	Wet	24 (160%)	-5 (-11%)
	Above Normal	13 (93%)	-4 (-13%)
	Below Normal	20 (154%)	-2 (-6%)
	Dry	31 (135%)	-2 (-4%)
	Critical	26 (433%)	1 (3%)
	All	114 (161%)	-12 (-6%)
July	Wet	43 (36%)	2 (1%)
	Above Normal	20 (45%)	0 (0%)
	Below Normal	27 (46%)	-1 (-1%)
	Dry	38 (54%)	2 (2%)
	Critical	38 (73%)	6 (7%)
	All	166 (48%)	9 (2%)
August	Wet	43 (48%)	10 (8%)
	Above Normal	20 (80%)	2 (5%)
	Below Normal	33 (87%)	4 (6%)
	Dry	48 (120%)	-5 (-5%)
	Critical	31 (74%)	-9 (-11%)
	All	175 (75%)	2 (1%)

NA = could not be calculated because the denominator was 0.

4

5 **H1/LOS**

6 ***Sacramento River***

7 Flows during this period would generally be similar between H1 and H3, except during November,  
 8 in which flows would be 3% to 17% lower, depending on water year type. Due to their low  
 9 magnitude and frequency, these flow reductions would not have biologically meaningful effects on  
 10 spring-run Chinook salmon rearing. September Shasta storage volume under H1 would generally be  
 11 similar to September storage volume under H3 (Table 11-4-36).

12 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
 13 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
 14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 16 NAA and H1 in any month or water year type throughout the period at either location.

1 **Clear Creek**

2 Flows in Clear Creek during the November through March rearing period under H1 would generally  
3 be similar to flows under H3. Therefore, results for H1 regarding larval and juvenile spring-run  
4 Chinook salmon rearing habitat in Clear Creek would be similar to those under H3.

5 **Feather River**

6 Flows in the Feather River low-flow channel during November through June would not differ  
7 between H1 and H3 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows in  
8 the high-flow channel under H1 during November through June juvenile rearing period would  
9 generally be similar to or greater than flows under H3. May and September Oroville storage under  
10 H1 would generally be similar to or greater than storage under H3 (Table 11-4-39, Table 11-4-45).

11 **Table 11-4-45. Difference and Percent Difference in May Water Storage Volume (thousand**  
12 **acre-feet) in Oroville Reservoir for H1, H3, and H4 Scenarios**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	2 (0.1%)	-374 (-10.9%)
Above Normal	-5 (-0.2%)	-487 (-14.7%)
Below Normal	77 (2.6%)	-391 (-13.5%)
Dry	167 (7.5%)	69 (3.1%)
Critical	83 (5.7%)	372 (25.6%)

13

14 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
15 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
16 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
17 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
18 between NAA and H1 in any month or water year type throughout the period at either location.

19 Differences in the percent of months exceeding the 63°F threshold between NAA and H1 would  
20 generally be negligible (<5% on an absolute scale) during May and between 0% and 23% (absolute  
21 scale) lower under H1 during June through August (Table 11-4-46). This represents a small to  
22 moderate benefit of H1 on spring-run Chinook salmon juvenile rearing habitat conditions in the  
23 Feather River.

1 **Table 11-4-46. Differences between Baselines and H1 and H4 Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River above Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
May	2 (NA)	2 (NA)	0 (NA)	0 (NA)	0 (NA)
June	26 (47%)	27 (100%)	23 (475%)	7 (NA)	2 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	47 (119%)
August	0 (0%)	12 (14%)	36 (62%)	48 (170%)	41 (413%)
<b>NAA vs. H1</b>					
May	-4 (-60%)	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)
June	-7 (-8%)	-23 (-30%)	-19 (-39%)	-14 (-65%)	-2 (-50%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-7 (-8%)
August	0 (0%)	0 (0%)	-5 (-5%)	-5 (-6%)	-6 (-11%)
<b>EXISTING CONDITIONS vs. H4</b>					
May	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
June	26 (47%)	31 (114%)	33 (675%)	15 (NA)	4 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	51 (128%)
August	0 (0%)	12 (14%)	41 (70%)	53 (187%)	48 (488%)
<b>NAA vs. H4</b>					
May	-4 (-60%)	-1 (-50%)	-1 (-100%)	0 (NA)	0 (NA)
June	-7 (-8%)	-20 (-25%)	-9 (-18%)	-6 (-29%)	-1 (-25%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-4 (-4%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2%)

NA = could not be calculated because the denominator was 0.

4

5 Combining all water year types, total degree-months above the 63°F threshold under H1 would  
 6 generally be similar (<5% difference) to those under NAA during May, July, and August but 9%  
 7 lower during June (Table 11-4-47). Results by water year type are generally similar to those by  
 8 combining all water year types, except during August, in which total degree-months under H1 would  
 9 generally be higher under NAA in wetter water years and lower in drier water year types.

1 **Table 11-4-47. Differences between Baseline and H1 and H4 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in**  
 3 **the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
May	Wet	1 (NA)	0 (0%)	1 (NA)	0 (0%)
	Above Normal	1 (NA)	0 (0%)	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	2 (NA)	0 (0%)	2 (NA)	0 (0%)
	Critical	4 (NA)	0 (0%)	4 (NA)	0 (0%)
	All	8 (NA)	0 (0%)	8 (NA)	0 (0%)
June	Wet	25 (167%)	-4 (-9%)	24 (160%)	-5 (-11%)
	Above Normal	13 (93%)	-4 (-13%)	13 (93%)	-4 (-13%)
	Below Normal	18 (138%)	-4 (-11%)	18 (138%)	-4 (-11%)
	Dry	30 (130%)	-3 (-5%)	30 (130%)	-3 (-5%)
	Critical	23 (383%)	-2 (-6%)	23 (383%)	-2 (-6%)
	All	109 (154%)	-17 (-9%)	108 (152%)	-18 (-9%)
July	Wet	43 (36%)	2 (1%)	43 (36%)	2 (1%)
	Above Normal	20 (45%)	0 (0%)	20 (45%)	0 (0%)
	Below Normal	27 (46%)	-1 (-1%)	27 (46%)	-1 (-1%)
	Dry	39 (55%)	3 (3%)	40 (56%)	4 (4%)
	Critical	38 (73%)	6 (7%)	39 (75%)	7 (8%)
	All	167 (48%)	10 (2%)	169 (49%)	12 (2%)
August	Wet	42 (47%)	9 (7%)	42 (47%)	9 (7%)
	Above Normal	21 (84%)	3 (7%)	21 (84%)	3 (7%)
	Below Normal	30 (79%)	1 (1%)	32 (84%)	3 (4%)
	Dry	43 (108%)	-10 (-11%)	47 (118%)	-6 (-6%)
	Critical	33 (79%)	-7 (-9%)	32 (76%)	-8 (-10%)
	All	169 (72%)	-4 (-1%)	174 (74%)	1 (0.2%)

NA = could not be calculated because the denominator was 0.

4  
 5 Overall, due to similarities in flows, water temperatures, and storage volume between H1 and H3,  
 6 results for H1 regarding larval and juvenile spring-run Chinook salmon rearing habitat in the  
 7 Feather River would be similar to those for H3, although temperature conditions in the Feather  
 8 River would be slightly better under H1.

9 **H4/HOS**

10 ***Sacramento River***

11 Flows during this period would generally be similar between H4 and H3. September Shasta storage  
 12 volume under H4 would generally be similar to September storage volume under H3 (Table 11-4-  
 13 36). Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
 14 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
 15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 17 NAA and H4 in any month or water year type throughout the period at either location.

1 **Clear Creek**

2 Flows in Clear Creek during the November through March rearing period under H4 would generally  
3 be similar to flows under H3. Therefore, results for H4 regarding larval and juvenile spring-run  
4 Chinook salmon rearing habitat in Clear Creek would be similar to those under H3.

5 **Feather River**

6 Flows in the Feather River low-flow channel during November through June would not differ  
7 between H4 and H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in  
8 the high-flow channel under H4 during November through June juvenile rearing period would  
9 generally be similar to or greater than flows under H3, except during June, in which flows would be  
10 up to 39% lower than under H3. Because these reductions occur in only one month at the end of the  
11 rearing period, they are not expected to have biologically meaningful effects on spring-run rearing  
12 habitat. May storage would be 11% to 15% lower under H4 relative to H3 in wet, above normal, and  
13 below normal water years (Table 11-4-45). September Oroville storage under H4 would generally  
14 be similar to or greater than storage under H3 (Table 11-4-39).

15 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
16 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
17 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
18 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
19 between NAA and H4 in any month or water year type throughout the period at either location.

20 Differences in the percent of months exceeding the 63°F threshold between NAA and H4 would be  
21 negligible (<5% on an absolute scale) during May, July, and August and between 1% and 20%  
22 (absolute scale) lower under H4 during June (Table 11-4-46). This represents a small to moderate  
23 benefit of H4 on spring-run spawning habitat conditions in the Feather River.

24 Combining all water year types, total degree-months above the 63°F threshold under H4 would be  
25 similar (<5% difference) to those under NAA during May, July, and August, but 9% lower during  
26 June (Table 11-4-47). Results by water year type are generally similar to those by combining all  
27 water year types, except during August, in which total degree-months are generally higher under  
28 NAA in wetter water years and lower in drier water year types.

29 Overall, due to similarities in flows and water temperatures between H4 and H3, results for H4  
30 regarding larval and juvenile spring-run Chinook salmon rearing habitat in the Feather River would  
31 be similar to those for H3, although temperature conditions in the Feather River would be better  
32 under H4.

33 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because habitat would  
34 not be substantially reduced. Although SacEFT predicts that rearing habitat conditions in the  
35 Sacramento River would be reduced by Alternative 4, SALMOD predicts no substantial effects on  
36 spring-run rearing habitat. In the Feather River, habitat conditions would improve under Alternative  
37 4 relative to the NAA, particularly in H1 and H4 scenarios. There would be no effects in Clear Creek.

38 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
39 and quality of rearing habitat for spring-run Chinook salmon would be not be affected relative to the  
40 CEQA baseline.

1 **H3/ESO**

2 ***Sacramento River***

3 Flows were evaluated during the November through March larval and juvenile spring-run Chinook  
4 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red  
5 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Keswick, flows under  
6 H3 would be up to 22% greater during February and similar in the remaining months. Upstream of  
7 Red Bluff, flows under H3 would generally be up to 26% lower during November than under  
8 Existing Conditions and similar in the remaining months. These results indicate that there would  
9 very few reductions in flows due to H3 in the Sacramento River.

10 As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under H3 would  
11 be similar to volume under Existing Conditions in wet and above normal water years and 8% to  
12 25% lower than volume under Existing Conditions in below normal, dry, and critical water years  
13 (Table 11-4-19). As reported in AQUA-58, Shasta Reservoir storage volume at the end of September  
14 under H3 would be 15% to 33% lower relative to Existing Conditions (Table 11-4-27).

15 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
16 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
17 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
18 *Fish Analysis*). At both sites, mean monthly water temperature under H3 would be similar to those  
19 under Existing Conditions in all months except August through October, in which temperatures  
20 would be 5% to 6% higher under H3.

21 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,  
22 measured as weighted usable area, under H3 would be 18% lower than under Existing Conditions  
23 (Table 11-4-31). In addition, the percentage of years with good (low) juvenile stranding risk under  
24 H3 is predicted to be 37% lower than under Existing Conditions. This indicates that the quantity and  
25 quality of juvenile rearing habitat in the Sacramento River would be lower under H3 relative to  
26 Existing Conditions.

27 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under H3 would be  
28 32% lower than under Existing Conditions.

29 ***Clear Creek***

30 Flows in Clear Creek during the November through March rearing period under H3 would generally  
31 be similar to flows under Existing Conditions, except during March, in which flows would be up to  
32 29% greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 Water temperatures were not model in Clear Creek.

34 ***Feather River***

35 Relatively constant flows in the low-flow channel throughout the November through June rearing  
36 period under H3 would not differ from those under Existing Conditions. In the high-flow channel,  
37 flows under H3 would generally be up to 61% lower than flows under Existing Conditions during  
38 January, February, and December, up to 209% greater than flows under Existing Conditions during  
39 April through June, and similar during March and November.

1 May Oroville storage volume under H3 would be similar to volume under Existing Conditions in wet  
2 years and 5% to 20% lower than volume under Existing Conditions in other water year types (Table  
3 11-4-42).

4 As reported in Impact AQUA-58, September Oroville storage volume would be 10% to 35% lower  
5 under H3 relative to Existing Conditions depending on water year type (Table 11-4-33).

6 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
7 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
8 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in  
9 the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under H3 would be  
10 6% to 10% higher during November through March and not different during April through June. In  
11 the high-flow channel, mean monthly water temperatures under H3 would be 6% to 8% higher  
12 during November through February and not different during March through June.

13 Effects of H3 on water temperature-related effects on spring-run Chinook salmon juvenile rearing  
14 conditions in the Feather River were analyzed by comparing the percent of months between May  
15 and August over the 82-year CALSIM modeling period that exceed a 63°F temperature threshold in  
16 the low-flow channel (above Thermalito Afterbay) (Table 11-4-43). In general, the percent of  
17 months exceeding the threshold under H3 would be similar or up to 59% greater (absolute scale)  
18 than those under Existing Conditions. This comparison includes the effects of climate change.

19 The effects of H3 on water temperature-related juvenile rearing conditions for spring-run Chinook  
20 salmon in the Feather River were also analyzed by comparing the total degree-months for months  
21 that exceed the 56°F NMFS threshold during May through August for all 82 years (Table 11-4-44).  
22 Combining all water year types, there would be a very small difference (8 degree-months) between  
23 Existing Conditions and H3 during May, but up to 161% increase in degree-months during June, July,  
24 and August. This comparison includes the effects of climate change.

## 25 **H1/LOS**

### 26 ***Sacramento River***

27 Flows during this period would generally be similar between H1 and H3, except during November,  
28 in which flows would be 3% to 17% lower, depending on water year type. Due to their low  
29 magnitude and frequency, these flow reductions would not have biologically meaningful effects on  
30 spring-run Chinook salmon rearing. September Shasta storage volume under H1 would generally be  
31 similar to May and September storage volume under H3 (Table 11-4-36).

32 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
33 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the  
35 Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water  
36 temperature between Existing Conditions and H1 in any month except August through October,  
37 which would be 5% to 6% higher.

### 38 ***Clear Creek***

39 Flows in Clear Creek during the November through March rearing period under H1 would generally  
40 be similar to flows under H3. Therefore, results for H1 regarding larval and juvenile spring-run  
41 Chinook salmon rearing habitat in Clear Creek would be similar to those under H3.

1 **Feather River**

2 Flows in the Feather River low-flow channel during November through June would not differ  
3 between H1 and H3 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows in  
4 the high-flow channel under H1 during November through June juvenile rearing period would  
5 generally be similar to or greater than flows under H3. May and September Oroville storage under  
6 H1 would generally be similar to or greater than storage under H1 (Table 11-4-39, Table 11-4-45).

7 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
8 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
9 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
10 *the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under H1 would be  
11 6% to 9% higher during November through March and not different during April through June. In  
12 the high-flow channel, mean monthly water temperatures under H1 would be 6% to 8% higher  
13 during November through February and not different during March through June.

14 Differences in the percent of months exceeding the 63°F threshold between Existing Conditions and  
15 H1 would generally be negligible (<5% on an absolute scale) during May and between 0% and 48%  
16 (absolute scale) higher under H1 during June through August (Table 11-4-46). This comparison  
17 includes the effects of climate change.

18 Combining all water year types, there would be a very small difference (8 degree-months) between  
19 Existing Conditions and H1 during May, but up to 154% increase in degree-months during June, July,  
20 and August. (Table 11-4-47). This comparison includes the effects of climate change. Results by  
21 water year type are similar to those by combining all water year types but differ in magnitude of  
22 differences between Existing Conditions and H1.

23 Overall, due to similarities in flows, water temperatures, and storage volume between H1 and H3,  
24 results for H1 regarding larval and juvenile spring-run Chinook salmon rearing habitat in the  
25 Feather River would be similar to those for H3.

26 **H4/HOS**

27 ***Sacramento River***

28 Flows during this period would generally be similar between H4 and H3. September Shasta storage  
29 volume under H4 would generally be similar to September storage volume under H3 (Table 11-4-  
30 36).

31 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
32 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,  
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
34 *Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water  
35 temperature between Existing Conditions and H4 in any month except August through October,  
36 which would be 5% to 6% higher.

37 ***Clear Creek***

38 Flows in Clear Creek during the November through March rearing period under H4 would generally  
39 be similar to flows under H3. Therefore, results for H4 regarding larval and juvenile spring-run  
40 Chinook salmon rearing habitat in Clear Creek would be similar to those under H3.

1 **Feather River**

2 Flows in the Feather River low-flow channel during November through June would not differ  
3 between H4 and H3 (Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis). Flows in  
4 the high-flow channel under H4 during November through June juvenile rearing period would  
5 generally be similar to or greater than flows under H3, except during June, in which flows would be  
6 up to 39% lower than under H3. Because these reductions occur in only one month at the end of the  
7 rearing period, they are not expected to have biologically meaningful effects on spring-run rearing  
8 habitat. May storage would be 11% to 15% lower under H4 relative to H3 in wet, above normal, and  
9 below normal water years (Table 11-4-39). September Oroville storage under H4 would generally  
10 be similar to or greater than storage under H3 (Table 11-4-45).

11 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at  
12 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix  
13 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
14 *the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under H4 would be  
15 5% to 9% higher during November through March and not different during April through June. In  
16 the high-flow channel, mean monthly water temperatures under H4 would be 6% to 8% higher  
17 during November through February and not different during March through June.

18 Differences in the percent of months exceeding the 63°F threshold between Existing Conditions and  
19 H4 would be negligible (<5% on an absolute scale) during May and between 0% and 53% (absolute  
20 scale) lower under H4 during June, July, and August (Table 11-4-46). This comparison includes the  
21 effects of climate change.

22 Combining all water year types, total degree-months above the 63°F threshold under H4 would be  
23 similar to those under Existing Conditions during May, but 49% to 152% greater than those under  
24 Existing Conditions during June through August (Table 11-4-47). Results by water year type are  
25 generally similar to those by combining all water year types, although magnitudes of differences  
26 vary by water year type within months. This comparison includes the effects of climate change.

27 Overall, due to similarities in flows and water temperatures between H4 and H3, results for H4  
28 regarding larval and juvenile spring-run Chinook salmon rearing habitat in the Feather River would  
29 be similar to those for H3.

30 **Summary of CEQA Conclusion**

31 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between  
32 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
33 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA  
34 conclusion set forth above. There would be small to moderate flow-related effects of Alternative 4  
35 on spring-run Chinook salmon in the Sacramento and Feather rivers and temperature-related effects  
36 in the Feather River. Both SacEFT and SALMOD predict reduced habitat conditions for spring-run  
37 Chinook salmon in the Sacramento River. Exceedances above NMFS temperature thresholds would  
38 be higher under Alternative 4 relative to Existing Conditions. Results would be similar among model  
39 scenarios.

40 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
41 change, future water demands, and implementation of the alternative. The analysis described above  
42 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
43 alternative from those of sea level rise, climate change and future water demands using the model

1 simulation results presented in this chapter. However, the increment of change attributable to the  
2 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
3 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
4 implementation period, which does include future sea level rise, climate change, and water  
5 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
6 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
7 effect of the alternative from those of sea level rise, climate change, and water demands.

8 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
9 term implementation period and H3 indicates that flows in the locations and during the months  
10 analyzed above would generally be similar between future conditions without BDCP and H3. This  
11 indicates that the differences between Existing Conditions and Alternative 4 found above would  
12 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
13 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
14 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
15 impact on rearing habitat for spring-run Chinook salmon. This impact is found to be less than  
16 significant and no mitigation is required.

### 17 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon** 18 **(Spring-Run ESU)**

19 In general, the effects of Alternative 4 on spring-run Chinook salmon migration conditions relative  
20 to the NAA are uncertain.

#### 21 **Upstream of the Delta**

##### 22 **H3/ESO**

##### 23 ***Sacramento River***

24 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through  
25 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*  
26 *utilized in the Fish Analysis*). Flows under H3 would generally be up to 12% greater than flows under  
27 NAA during May and similar to flows under NAA during December through April.

28 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through  
29 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*  
30 *Model Results utilized in the Fish Analysis*). Flows under H3 during May and June would generally be  
31 up to 12% greater than flows under NAA and similar to flows under NAA during April, July, and  
32 August.

33 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
34 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
35 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
36 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
37 NAA and H3 in any month or water year type throughout the period.

1       **Clear Creek**

2       Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run  
3       migration period under H3 would generally be similar to or greater than flows under NAA  
4       throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5       Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream  
6       migration period under H3 would be similar to flows under NAA, except in critical water years  
7       during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8       Water temperatures were not modeled in Clear Creek.

9       **Feather River**

10       Flows in the Feather River at the confluence with the Sacramento River were examined during the  
11       November through May juvenile spring-run Chinook salmon migration period (Appendix 11C,  
12       *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 during April and May would be  
13       up to 23% greater than flows under NAA and similar to flows under NAA in the remaining months.

14       Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
15       were examined during the November through May juvenile spring-run Chinook salmon migration  
16       period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
17       *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
18       temperature between NAA and H3 in any month or water year type throughout the period.

19       Flows in the Feather River at the confluence with the Sacramento River were examined during the  
20       April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,  
21       *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 during July and August would  
22       generally be up to 53% lower than flows under NAA, up to 65% greater than flows under NAA  
23       during May and June, and similar to flows under NAA during April. Although these reductions would  
24       be of moderate to large magnitude, flows under H3 during these months would generally exceed  
25       flows suggested by NMFS during the BDCP planning process at similar frequencies as those under  
26       NAA (Table 11-4-48). Therefore, these reduced flows would not affect spring-run Chinook salmon in  
27       a biologically meaningful way.

1 **Table 11-4-48. Differences (Percentage Differences) in the Percentage of Years Exceeding NMFS**  
2 **Suggested Minimum Flows in the Feather River High-Flow Channel (at Thermalito)**

	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>Above Normal Water Year Type</b>		
October	0 (0%)	0 (0%)
November	0 (0%)	0 (0%)
December	9.1 (50%)	-18.2 (-40%)
January	-27.3 (-60%)	0 (0%)
February	0 (0%)	0 (0%)
March	9.1 (25%)	9.1 (25%)
April	0 (NA)	0 (NA)
May	9.1 (100%)	9.1 (100%)
June	18.2 (25%)	0 (0%)
July	0 (0%)	0 (0%)
August	9.1 (10%)	0 (0%)
September	36.4 (57.2%)	0 (0%)
<b>Below Normal Water Year Type</b>		
October	-7.7 (-9.1%)	0 (0%)
November	-7.7 (-10%)	0 (0%)
December	0 (0%)	0 (0%)
January	-35.8 (-83.4%)	-7.2 (-50.3%)
February	-14.3 (-33.3%)	0 (0%)
March	-21.4 (-100%)	-7.1 (-100%)
April	7.1 (NA)	7.1 (NA)
May	7.1 (NA)	7.1 (NA)
June	28.6 (44.5%)	0 (0%)
July	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)
September	-35.7 (-45.4%)	-50 (-53.8%)
NA = could not be calculated because the denominator was 0.		

3  
4 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
5 were examined during the April through August adult spring-run Chinook salmon upstream  
6 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
7 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
8 mean monthly water temperature between NAA and H3 in any month or water year type  
9 throughout the period.

10 **H1/LOS**

11 ***Sacramento River***

12 Flows under H1 in the Sacramento River upstream of Red Bluff during the December through May  
13 juvenile spring-run Chinook salmon migration period and the April through August adult upstream  
14 migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*

1 *Results utilized in the Fish Analysis*). Because flows would be similar between H1 and H3, results for  
2 H1 regarding migration conditions for spring-run Chinook salmon in the Sacramento River would be  
3 similar to those for H3.

4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
5 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
8 NAA and H1 in any month or water year type throughout the period.

#### 9 **Clear Creek**

10 Flows under H1 in Clear Creek during the November through May juvenile spring-run Chinook  
11 salmon migration period and the April through August adult upstream migration period would  
12 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
13 *Analysis*). Because flows would be similar between H1 and H3, results for H1 regarding migration  
14 conditions for spring-run Chinook salmon in Clear Creek would be similar to those for H3.

#### 15 **Feather River**

16 Flows under H1 in the Feather River at the confluence with the Sacramento River during the  
17 November through May juvenile spring-run Chinook salmon migration period and the April through  
18 August adult upstream migration period would generally be similar to flows under H3 (Appendix  
19 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This lack of reduction in flows is further  
20 confirmed by evaluating the exceedance of flows suggested by NMFS during the BDCP planning  
21 process for the Feather River (Table 11-4-49). Flows under H1 in both above and below normal  
22 water years during both periods would generally be similar to exceedances under H3. Because flows  
23 would be similar between H1 and H3, results for H1 regarding migration conditions for spring-run  
24 Chinook salmon in the Feather River would be similar to those for H3.

25 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
26 were examined during the April through August adult spring-run Chinook salmon upstream  
27 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
28 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
29 mean monthly water temperature between NAA and H1 in any month or water year type  
30 throughout the period.

1 **Table 11-4-49. Differences (Percentage Differences) in the Percentage of Years Exceeding NMFS**  
 2 **Suggested Minimum Flows in the Feather River High-Flow Channel (at Thermalito) between the**  
 3 **H3 Model Scenario and H1 and H4 Model Scenarios**

	H3 vs. H1	H3 vs. H4
<b>Above Normal Water Year Type</b>		
October	9.1 (12.5%)	9.1 (12.5%)
November	0 (0%)	0 (0%)
December	9.1 (33.3%)	-18.2 (-66.7%)
January	18.2 (100%)	9.1 (50%)
February	0 (0%)	9.1 (14.3%)
March	0 (0%)	0 (0%)
April	0 (NA)	36.4 (NA)
May	0 (0%)	9.1 (50%)
June	0 (0%)	-18.2 (-20%)
July	0 (0%)	-9.1 (-9.1%)
August	0 (0%)	-27.3 (-27.3%)
September	-81.8 (-81.8%)	-72.7 (-72.7%)
<b>Below Normal Water Year Type</b>		
October	0 (0%)	0 (0%)
November	0 (0%)	7.7 (11.1%)
December	0 (NA)	0 (NA)
January	0 (0%)	0 (0%)
February	-7.1 (-100%)	7.2 (101.4%)
March	7.1 (24.8%)	7.1 (24.8%)
April	7.1 (NA)	7.1 (NA)
May	-7.1 (-100%)	28.6 (402.8%)
June	0 (0%)	7.2 (101.4%)
July	0 (0%)	7.1 (7.6%)
August	0 (0%)	-7.1 (-7.1%)
September	0 (0%)	-7.1 (-7.1%)

NA = could not be calculated because the denominator was 0.

4

5 **H4/HOS**

6 ***Sacramento River***

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the December through May  
 8 juvenile spring-run Chinook salmon migration period would generally be similar to flows under H3.  
 9 Flows under H4 during the April through August adult upstream migration period would generally  
 10 be similar to flows under H3, except during June, in which flows would be up to 12% lower under  
 11 H4, and during August, in which flows would be up to 13% greater under H4. These differences in  
 12 flows between H4 and H3 scenarios would not be large or frequent enough to have biologically  
 13 meaningful effects on spring-run Chinook salmon adult migration conditions. Therefore, because  
 14 flows and water temperatures would be similar between H4 and H3, results for H4 regarding

1 migration conditions for spring-run Chinook salmon in the Sacramento River would be similar to  
2 those for H3.

3 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
4 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 NAA and H4 in any month or water year type throughout the period.

#### 8 **Clear Creek**

9 Flows under H4 in Clear Creek during the November through May juvenile spring-run Chinook  
10 salmon migration period and the April through August adult upstream migration period would  
11 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
12 *Analysis*). Because flows would be similar between H4 and H3, results for H4 regarding migration  
13 conditions for spring-run Chinook salmon in Clear Creek would be similar to those for H3.

#### 14 **Feather River**

15 Flows under H4 in the Feather River at the confluence with the Sacramento River during the  
16 November through May juvenile spring-run Chinook salmon migration period and the April through  
17 August adult upstream migration period would generally be similar to flows under H3 (Appendix  
18 11C, *CALSIM II Model Results utilized in the Fish Analysis*), except during April and May in which  
19 flows would be up to 100% greater under H4. The exceedance of monthly flows in the Feather River  
20 suggested by NMFS during the BDCP planning process would differ between H4 and H3 (Table 11-4-  
21 49). Flows during the April through August adult upstream migration period would vary by month.  
22 flows would be lower under H4 relative to H3 during June through August and higher during  
23 January, February and May of above normal water years, but there would be no difference between  
24 H4 and H3 in below normal years.

25 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
26 were examined during the April through August adult spring-run Chinook salmon upstream  
27 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
28 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
29 mean monthly water temperature between NAA and H4 in any month or water year type  
30 throughout the period.

#### 31 **Through-Delta**

##### 32 **Juveniles**

33 Scenario H3 operations would reduce OMR reverse flows (Appendix 11C, *CALSIM II Model Results*  
34 *utilized in the Fish Analysis*), with a corresponding increase in net positive downstream flows, during  
35 the outmigration period of Chinook salmon through the interior Delta channels. Conditions under  
36 Scenario H1 and Scenario H3 would result in slightly decreased OMR flows in April and May relative  
37 to NAA, however flows during these months would still be net positive (flowing towards the sea).  
38 OMR flows under Scenario H4 would generally be improved compared to NAA conditions during all  
39 water year types throughout the migration period. These improved net positive downstream flows  
40 would be substantial benefits of the proposed operations.

1 Flows downstream of the north Delta intakes would be reduced, which may increase predation  
 2 potential. During the juvenile spring-run Chinook salmon emigration period (December through  
 3 May), mean monthly flows under Scenario H3 in the Sacramento River below the NDD would be  
 4 lower (14% to 23% reduced in monthly mean across years) compared to NAA. Flows would be up to  
 5 27% to 28% lower in April and November of above normal years. Flows below the NDD would be  
 6 similar for Scenarios H3 and H1. Under the high spring outflow Scenario, H4, flows during April and  
 7 May would not decrease as much (5% to 9% lower) compared to NAA.

8 The three North Delta intake facilities proposed on the Sacramento River under Alternative 4 would  
 9 displace aquatic habitat and attract predatory fish to the structure. Potential predation at the three  
 10 North Delta intakes was estimated in two ways. Bioenergetics modeling with a median predator  
 11 density predicts a predation loss of about 8,200 juveniles, or 0.2% of the spring-run juvenile  
 12 population under Alternative 4 (Table 11-4-50). A conservative assumption of 5% loss per intake  
 13 would yield a cumulative loss of 12% of juvenile spring-run Chinook that reach the north Delta. This  
 14 assumption is uncertain and represents an upper bound estimate. In addition, the three intake  
 15 structures would result in a permanent loss of 13.7 acres aquatic habitat and 7,450 linear feet of  
 16 shoreline. This topic is discussed further in Impact AQUA-42 for Alternative 1A.

17 **Table 11-4-50. Juvenile Spring-Run Chinook Salmon Predation Loss at the proposed North Delta**  
 18 **Diversion intakes for Alternative 4 (Three Intakes)**

Striped Bass at NDD (Three Intakes)			Spring-Run Chinook Consumed	
Density Assumption	Bass per 1,000 feet of Intake	Total Number of Bass	Number	Percentage of Annual Juvenile Production
Low	18	86	1,243	0.03%
Median	119	571	8,217	0.20%
High	219	1,051	15,122	0.36%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

19  
 20 As estimated by the Delta Passage Model, through-Delta survival under Scenario H3 by juvenile  
 21 spring-run Chinook salmon Alternative 4 averaged 29% across all years, ranging from about 24% in  
 22 drier years to 38% in wetter years (Table 11-4-51). Scenario H3 survival was similar to NAA in both  
 23 drier years (0.5% less survival, or 2% less in relative difference) and wetter years (2.5% reduced  
 24 survival, or 6% less in relative difference) (Table 11-4-51).

25 Survival under Scenario H1 (low outflow) was similar to Scenario H3 and NAA (averages around  
 26 21%) (Table 11-4-51). Average survival under Scenario H4 (high outflow) was 30.7%, compared to  
 27 29.1% for Scenarios H1 and H3 and 30.3% for NAA. In wetter years, Scenario H4 had 2% greater  
 28 survival, a 5% relative difference compared to NAA. This difference was driven by appreciably  
 29 higher survival in wetter years (the above-normal year of 1980 and the wet year of 1984) as a result  
 30 of greater outflow under Scenario H4.

1 **Table 11-4-51. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under**  
 2 **Alternative 4 (Scenarios H3, H1 and H4)**

Water Year Type	Average Percentage Survival					Difference in Percentage Survival (Relative Difference)					
	Scenario					EXISTING CONDITIONS vs. Alt 4 Scenario			NAA vs. Alt 4 Scenario		
	EXISTING CONDITIONS	NAA	H3	H1	H4	H3	H1	H4	H3	H1	H4
Wetter Years	42.1	40.4	37.9	37.9	42.4	-4.2 (-10%)	-4.2 (-10%)	0.3 (1%)	-2.5 (-6%)	-2.5 (-6%)	2.0 (5%)
Drier Years	24.8	24.3	23.7	23.8	23.7	-1.0 (-4%)	-1.0 (-4%)	-1.1 (-5%)	-0.5 (-2%)	-0.5 (-2%)	-0.6 (-3%)
All Years	31.3	30.3	29.1	29.1	30.7	-2.2 (-7%)	-2.2 (-7%)	-0.6 (-2%)	-1.3 (-4%)	-1.2 (-4%)	0.4 (1%)

Note: Average Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal Water Years (6 years).

Drier = Below Normal, Dry and Critical Water Years (10 years).

H3 = ESO operations, H1 = Low Outflow, H4 = High Outflow.

3

4 **Adults**

5 As described for winter-run Chinook, attraction flows and olfactory cues in the west Delta would be  
 6 altered because of shifts in exports from the south Delta to the north Delta. Flows in the Sacramento  
 7 River downstream of the north Delta intake diversions would be reduced, with concomitant  
 8 proportional increases in San Joaquin River flows. The flow changes under Scenario H3 would  
 9 slightly decrease the olfactory cues for migrating adult salmon in the Sacramento River (by 9% or  
 10 less compared to NAA) and slightly increase the olfactory cues for the San Joaquin River (Table 11-  
 11 4-52). Conditions under Scenario H4 are expected to reduce the magnitude of this effect because it  
 12 would involve fewer exports from the north Delta compared to Scenario H3 and Scenario 1.

13 **Table 11-4-52. Percentage (%) of Water at Collinsville that Originated in the Sacramento during**  
 14 **the Adult Spring-Run Chinook Salmon Migration Period for Alternative 4 (Scenario H3)**

Month	EXISTING CONDITIONS	NAA	A4 (H3)	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
March	78	76	68	-10	-8
April	77	75	66	-11	-9
May	69	65	59	-10	-6
June	64	62	58	-6	-4

Shading indicates 10% or greater absolute difference.

15

16 **NEPA Effects:** Upstream of the Delta, these results indicate that the effect would not be adverse  
 17 because it does not have the potential to substantially interfere with the movement of fish. Flows in  
 18 the Sacramento River and Clear Creek and water temperatures in the Sacramento and Feather  
 19 Rivers would generally not be affected by Alternative 4. Flows under H3 and H4 scenarios in the  
 20 Feather River would be lower during summer months due to the Fall X2 standard, although flows  
 21 would otherwise not differ among scenarios.

1 Near-field effects of Alternative 4 NDD on spring-run Chinook salmon related to impingement and  
2 predation associated with three new intake structures could result in negative effects on juvenile  
3 migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall  
4 effects. It is expected that the level of near-field impacts would be directly correlated to the number  
5 of new intake structures in the river and thus the level of impacts associated with 3 new intakes  
6 would be considerably lower than those expected from having 5 new intakes in the river. Estimates  
7 within the effects analysis range from very low levels of effects (<1% mortality) to more significant  
8 effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the  
9 intent of providing localized and temporary reductions in predation pressure at the NDD.  
10 Additionally, several pre-construction surveys to better understand how to minimize losses  
11 associated with the three new intake structures will be implemented as part of the final NDD screen  
12 design effort. Alternative 4 also includes an Adaptive Management Program and Real-Time  
13 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide  
14 adequate migration conditions for spring-run Chinook. However, at this time, due to the absence of  
15 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality  
16 expected from near-field effects at the NDD remains highly uncertain.

17 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
18 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
19 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 4  
20 predict improvements in smolt condition and survival associated with increased access to the Yolo  
21 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
22 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
23 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

24 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
25 all of these elements of BDCP operations and conservation measures to predict smolt migration  
26 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
27 migration survival under Alternative 4 would be similar to those estimated for NAA. Further  
28 refinement and testing of the DPM, along with several ongoing and planned studies related to  
29 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
30 future. These efforts are expected to improve our understanding of the relationships and  
31 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
32 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
33 However, until these efforts are completed and their results are fully analyzed, the overall  
34 cumulative effect of Alternative 4 on spring-run Chinook salmon migration remains uncertain.

35 **CEQA Conclusion:** In general, Alternative 4 would not affect migration conditions for spring-run  
36 Chinook salmon relative to the CEQA baseline.

## 37 **Upstream of the Delta**

### 38 ***Sacramento River***

39 Flows in the Sacramento River upstream of Red Bluff were examined during December through May  
40 juvenile spring-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results*  
41 *utilized in the Fish Analysis*). Flows under H3 during May would generally be up to 14% greater than  
42 flows under Existing Conditions, and similar to flows under Existing Conditions during December  
43 through April.

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
2 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 Existing Conditions and H3 in any month or water year type, except in critical years during January  
6 and wet years during May (5% lower in both).

7 Flows in the Sacramento River upstream of Red Bluff were examined during the April through  
8 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under H3 during May and June would generally be  
10 up to 20% greater than flows under Existing Conditions, up to 26% lower during August, and similar  
11 to flows under Existing Conditions during April and July.

12 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
13 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
16 Existing Conditions and H3 in any month except August, in which temperatures would be 6%  
17 greater under H3.

#### 18 **Clear Creek**

19 Flows in Clear Creek were examined during the November through May juvenile Chinook salmon  
20 spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
21 Flows under H3 would generally be greater than flows under Existing Conditions during March, but  
22 similar during the remaining months.

23 Flows in Clear Creek were examined during the April through August adult spring-run Chinook  
24 salmon upstream migration period. Flows under H3 would generally be similar to flows under  
25 Existing Conditions, with few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
26 *Analysis*).

27 Water temperatures were not modeled in Clear Creek.

#### 28 **Feather River**

29 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
30 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,  
31 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 16%  
32 lower than flows under Existing Conditions during November, and similar during December through  
33 May.

34 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
35 were examined during the November through May juvenile spring-run Chinook salmon migration  
36 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
37 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
38 temperature between Existing Conditions and H3 in any month except November and December, in  
39 which temperatures under H3 would be 5% greater.

40 Flows were examined for the Feather River at the confluence with the Sacramento River during the  
41 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,

1 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 64%  
2 lower than flows under Existing Conditions during July and August, and similar during April through  
3 June. However, the frequencies of exceedance above flow thresholds suggested by NMFS during the  
4 BDCP planning process under H3 would be similar to those under Existing Conditions during the  
5 two periods in above normal water years (Table 11-4-48). The frequencies of exceedance during the  
6 two periods in below normal water years would be lower during January through March.

7 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
8 were examined during the April through August adult spring-run Chinook salmon upstream  
9 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
10 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
11 mean monthly water temperature between Existing Conditions and H3 in any month except July and  
12 August, in which temperatures under H3 would be 6% greater.

### 13 **H1/LOS**

#### 14 ***Sacramento River***

15 Flows under H1 in the Sacramento River upstream of Red Bluff during the December through May  
16 juvenile spring-run Chinook salmon migration period and the April through August adult upstream  
17 migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
18 *Results utilized in the Fish Analysis*). Because flows would be similar between H1 and H3, results for  
19 H1 regarding migration conditions for spring-run Chinook salmon in the Sacramento River would be  
20 similar to those for H3.

21 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
22 December through May juvenile spring-run Chinook salmon migration period and the April through  
23 August adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and*  
24 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences  
25 (<5%) in mean monthly water temperature between Existing Conditions and H1 in any month  
26 except August, in which temperatures would be 6% greater under H1.

#### 27 ***Clear Creek***

28 Flows under H1 in Clear Creek during the November through May juvenile spring-run Chinook  
29 salmon migration period and the April through August adult upstream migration period would  
30 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
31 *Analysis*). Because flows would be similar between H1 and H3, results for H1 regarding migration  
32 conditions for spring-run Chinook salmon in Clear Creek would be similar to those for H3.

#### 33 ***Feather River***

34 Flows under H1 in the Feather River at the confluence with the Sacramento River during the  
35 November through May juvenile spring-run Chinook salmon migration period and the April through  
36 August adult upstream migration period would generally be similar to flows under H3 (Appendix  
37 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This lack of reduction in flows is further  
38 confirmed by evaluating the exceedance of flows suggested by NMFS during the BDCP planning  
39 process for the Feather River (Table 11-4-49). Flows under H1 in both above and below normal  
40 water years during both periods would generally be similar to exceedances under H3. Because flows

1 would be similar between H1 and H3, results for H1 regarding migration conditions for spring-run  
2 Chinook salmon in the Feather River would be similar to those for H3.

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
4 were examined during the November through May juvenile spring-run Chinook salmon migration  
5 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
6 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
7 temperature between Existing Conditions and H1 in any month except November and December, in  
8 which temperatures under H1 would be 5% greater.

9 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
10 were examined during the April through August adult spring-run Chinook salmon upstream  
11 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
12 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
13 mean monthly water temperature between Existing Conditions and H1 in any month except July and  
14 August, in which temperatures under H1 would be 6% greater.

#### 15 **H4/HOS**

##### 16 ***Sacramento River***

17 Flows under H4 in the Sacramento River upstream of Red Bluff during the December through May  
18 juvenile spring-run Chinook salmon migration period would generally be similar to flows under H3.  
19 Flows under H4 during the April through August adult upstream migration period would generally  
20 be similar to flows under H3, except during June, in which flows would be up to 12% lower under  
21 H4, and during August, in which flows would be up to 13% greater under H4. These differences in  
22 flows between H4 and H3 scenarios would not be large or frequent enough to have biologically  
23 meaningful effects on spring-run Chinook salmon adult migration conditions. Therefore, because  
24 flows and water temperatures would be similar between H4 and H3, results for H4 regarding  
25 migration conditions for spring-run Chinook salmon in the Sacramento River would be similar to  
26 those for H3.

27 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
28 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,  
29 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
30 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
31 Existing Conditions and H4 in any month except August, in which temperatures would be 6%  
32 greater under H4.

##### 33 ***Clear Creek***

34 Flows under H4 in Clear Creek during the November through May juvenile spring-run Chinook  
35 salmon migration period and the April through August adult upstream migration period would  
36 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
37 *Analysis*). Because flows would be similar between H4 and H3, results for H4 regarding migration  
38 conditions for spring-run Chinook salmon in Clear Creek would be similar to those for H3.

##### 39 ***Feather River***

40 Therefore, no further temperature analyses were conducted in the Feather River to assess spring-  
41 run Chinook salmon migration conditions. Flows under H4 in the Feather River at the confluence

1 with the Sacramento River during the November through May juvenile spring-run Chinook salmon  
 2 migration period and the April through August adult upstream migration period would generally be  
 3 similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*),  
 4 except during April and May in which flows would be up to 100% greater under H4. The exceedance  
 5 of monthly flows in the Feather River suggested by NMFS during the BDCP planning process would  
 6 be similar between H4 and H3 (Table 11-4-49). Flows during the April through August adult  
 7 upstream migration period would vary by month. Flows during April and May would be up to 100%  
 8 greater under H4, whereas flows during July through August would be up to 39% lower under H4.  
 9 The exceedance of monthly flows in the Feather River suggested by NMFS during the BDCP planning  
 10 process would be lower under H4 relative to H3 during June through August of above normal water  
 11 years, but there would be no difference between H3 and H4 in below normal years. These results  
 12 indicate that flows would be reduced in the Feather River by H4 relative to H3.

13 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
 14 were examined during the November through May juvenile spring-run Chinook salmon migration  
 15 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
 16 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
 17 temperature between Existing Conditions and H4 in any month except November and December, in  
 18 which temperatures under H4 would be 5% greater.

19 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
 20 were examined during the April through August adult spring-run Chinook salmon upstream  
 21 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
 22 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
 23 mean monthly water temperature between Existing Conditions and H4 in any month except July and  
 24 August, in which temperatures under H4 would be 6% to 7% greater.

## 25 **Through-Delta**

### 26 **Juveniles**

27 As described above, Scenarios H3 and H1 operations have similar through-Delta survival averaged  
 28 across all years compared to Existing Conditions (2.2% reduced survival, or 7% less in relative  
 29 difference) (Table 11-4-51). Survival under the high outflow Scenario H4 would be similar to  
 30 Existing Conditions (0.6% less averaged for all years, a 2% relative difference), particularly in  
 31 wetter years. Overall reductions in OMR reverse flows under all flow scenarios for Alternative 4  
 32 would be beneficial (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Conditions  
 33 under Scenario H4 would further improve OMR flow conditions (i.e., less reverse) relative to the  
 34 Scenario H3 and H1. Flows below the north Delta intakes would be reduced, which may increase  
 35 predation potential. The impact is considered less than significant due to similar or slightly greater  
 36 survival between Alternative 4 and Existing Conditions during all water year types. No mitigation  
 37 would be required.

### 38 **Adults**

39 As described above, attraction flows will be altered because of shifts in exports from the south Delta  
 40 to the north Delta. These changes would slightly decrease the olfactory cues for migrating adult  
 41 salmon in the Sacramento River (reduced by 10–11% in March-May under the Scenario H3  
 42 compared to Existing Conditions) and slightly increase olfactory cues for the San Joaquin River  
 43 (Table 11-4-52). Conditions between all flow scenarios under Alternative 4 would be similar; there

1 would only be small changes in olfactory cues for migrating adult salmon. Overall, impacts related to  
2 migration conditions for spring-run Chinook salmon are considered less than significant. No  
3 mitigation is required.

#### 4 **Summary of CEQA Conclusion**

5 Collectively, the results indicate that the effects would be less than significant because it would not  
6 substantially reduce the suitability of migration habitat or interfere with the movement of fish.  
7 Flows in the Sacramento River and Clear Creek and water temperatures in the Sacramento and  
8 Feather Rivers would generally not be affected by Alternative 4. Flows would be lower in 2 months  
9 of the 5-month adult migration period, although there would be no other flow reductions in the  
10 Feather River. Further, Alternative 4 would not reduce spring-run Chinook salmon juvenile survival  
11 through the Delta due to similar survival between Alternative 4 scenarios and Existing Conditions  
12 during all water year types and adult migration cues would not differ between Alternative 4  
13 scenarios and Existing Conditions. No mitigation is necessary.

#### 14 **Restoration Measures (CM2, CM4–CM7, and CM10)**

15 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
16 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
17 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
18 restoration measures described for spring-run Chinook salmon under Alternative 1A (Impacts  
19 AQUA-61 through AQUA-63) also appropriately characterize effects under Alternative 4.

20 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 21 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon** 22 **(Spring-Run ESU)**

#### 23 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook** 24 **Salmon (Spring-Run ESU)**

#### 25 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

26 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
27 on spring-run Chinook salmon are the same as those described under Alternative 1A (Impacts  
28 AQUA-61 through AQUA-63). The effects would not be adverse, and would generally be beneficial.  
29 Specifically for AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to  
30 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on  
31 spring-run Chinook salmon are uncertain.

32 **CEQA Conclusion:** All three of the impact mechanisms listed above would be at least slightly  
33 beneficial, or less than significant, for the reasons identified for Alternative 1A, and no mitigation is  
34 required.

#### 35 **Other Conservation Measures (CM12–CM19 and CM21)**

36 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
37 differences in other conservation-related fish effects are anticipated anywhere in the affected  
38 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
39 effects of other conservation measures described for spring-run Chinook salmon under Alternative

1 1A (Impacts AQUA-64 through AQUA-72) also appropriately characterize effects under Alternative  
2 4.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

4 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**  
5 **ESU) (CM12)**

6 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
7 **(Spring-Run ESU) (CM13)**

8 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**  
9 **Run ESU) (CM14)**

10 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**  
11 **(Spring-Run ESU) (CM15)**

12 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**  
13 **(CM16)**

14 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**  
15 **(CM17)**

16 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**  
17 **(CM18)**

18 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**  
19 **ESU) (CM19)**

20 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
21 **(Spring-Run ESU) (CM21)**

22 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms  
23 on spring-run Chinook salmon are the same as those described under Alternative 1A (Impacts AQUA-  
24 64 through AQUA-72). The effects range from no effect, to not adverse, to beneficial.

25 *CEQA Conclusion:* The effects of the nine impact mechanisms listed above range from no impact, to  
26 less than significant, to beneficial, and no mitigation is required.

## 27 **Fall-/Late Fall–Run Chinook Salmon**

### 28 **Construction and Maintenance of CM1**

29 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**  
30 **(Fall-/Late Fall–Run ESU)**

31 The potential effects of construction of the water conveyance facilities on fall-run/late fall-run  
32 Chinook salmon would be similar to those described for Alternative 1A, Impact AQUA-73, except  
33 that Alternative 4 would include three intakes instead of five intakes under Alternative 1A, so the  
34 effects would be proportionally less under this alternative. This would convert about 6,360 lineal  
35 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of

1 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
2 shoreline and would require 27.3 acres of dredging. Alternative 4 would use five barge locations  
3 rather than six as under Alternative 1A so those effects would also be proportionally less.  
4 Additionally, construction and excavation at Clifton Court Forebay would be done in the dry via  
5 installation of cofferdams for isolation and dewatering of work areas. Implementation of Appendix  
6 3B, *Environmental Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage*  
7 *Plan*, would minimize adverse effects as described for Alternative 1A. Mitigation measures would  
8 also be available to avoid and minimize potential effects.

9 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-73, the effect would not be adverse for  
10 fall-run/late fall-run Chinook salmon.

11 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-73, the impact of construction of the  
12 water conveyance facilities on fall-run/late fall-run Chinook salmon would not be significant except  
13 for construction noise associated with pile driving. Potential pile driving impacts would be less than  
14 Alternative 1A because only three intakes would be constructed rather than five. Implementation of  
15 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
16 less than significant.

17 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
18 **of Pile Driving and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
20 Alternative 1A.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
22 **and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
24 Alternative 1A.

25 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**  
26 **(Fall-/Late Fall-Run ESU)**

27 **NEPA Effects:** The potential effects of the maintenance of the water conveyance facilities under  
28 Alternative 4 would be the same as those described for Alternative 1A, Impact AQUA-74, except that  
29 only three intakes would need to be maintained under Alternative 4 rather than five under  
30 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-74, the impact would not be adverse  
31 for fall-run/late fall-run Chinook salmon.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-74, the impact of maintenance of  
33 the water conveyance facilities on fall-run/late fall-run Chinook salmon would be less than  
34 significant and no mitigation is required.

35 **Water Operations of CM1**

36 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**  
37 **Fall-Run ESU)**

38 Overall entrainment under Alternative 4 at the south Delta export facilities would be reduced for all  
39 water year types (Table 11-4-53). Under Scenario H3, average entrainment across all years would

1 be reduced 44% (~24,000 fish) for fall-run Chinook salmon and reduced 34% (627 fish) for late fall-  
2 run Chinook salmon compared to NAA.

3 **Table 11-4-53. Juvenile Fall-Run and Late Fall-Run Chinook Salmon Annual Entrainment Index<sup>a</sup> at**  
4 **the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 4**  
5 **(Scenario H3)**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
<b>Fall-run Chinook Salmon</b>		
Wet	-80,609 (-63%)	-80,786 (-63%)
Above Normal	-13,488 (-41%)	-13,962 (-42%)
Below Normal	-3,504 (-26%)	-3,864 (-28%)
Dry	-1,890 (-10%)	-3,538 (-17%)
Critical	-12,803 (-31%)	-7,626 (-21%)
All Years	-23,960 (-44%)	-24,016 (-44%)
<b>Late fall-run Chinook Salmon</b>		
Wet	-2,801 (-47%)	-2,714 (-46%)
Above Normal	-259 (-45%)	-245 (-44%)
Below Normal	-21 (-38%)	-18 (-34%)
Dry	-45 (-33%)	-29 (-24%)
Critical	-51 (-31%)	-38 (-25%)
All Years	-708 (-37%)	-627 (-34%)
Shading indicates 10% or greater increased entrainment.		
Note: Estimated annual number of fish lost, based on normalized data.		

6  
7 The annual juvenile population that approaches the Delta is assumed to be 23 million fall-run  
8 Chinook salmon and 1 million late fall-run Chinook salmon (juvenile index of abundance). The  
9 proportion of juvenile index of abundance lost at the south Delta facilities is very low for both runs  
10 under NAA (fall-run 0.24%, late fall-run 0.19% averaged for all years), and under Scenario H3  
11 decreases to negligible levels (fall-run 0.13%; late fall-run 0.12% A4\_LLT).

12 In general, most covered fish species occur within the Plan Area during winter-spring and, therefore,  
13 there would be little difference in south Delta entrainment between Scenarios H3 and H1 based on  
14 the similarity of south Delta export pumping for these scenarios. Lower south Delta export pumping  
15 during the spring under Scenario H4 would result in lower entrainment during this period.

16 Entrainment under Scenario H1 would be similar to Scenario H3, while conditions under Scenario  
17 H4 are expected to further reduce entrainment losses.

18 **Water Exports from SWP/CVP North Delta Intake Facilities**

19 The impact would be similar in type to Alternative 1A, but the degree would be less because  
20 Alternative 4 would have fewer intakes. Thus under Alternative 4 there would be about a 40%  
21 reduction in impingement and predation risk relative to Alternative 1A (Impact AQUA-75).

**Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

The impact of entrainment to the NBA would be the same as described for Alternative 1A (Impact AQUA-75). Entrainment and impingement effects would be minimal because intakes on the Sacramento River would have state-of-the-art screens installed.

**Predation Associated with Entrainment**

Entrainment-related predation loss at the south Delta facilities would be no greater and may be lower than baseline (NAA), due to a reduction in entrainment loss. Scenario H3 Entrainment-related predation losses are expected to decrease under Scenario H4 compared to Scenario H3, while predation losses would be similar or slightly increased under Scenario H1 compared to Scenario H3.

Predation at the north Delta would be increased due to the installation of the proposed SWP/CVP North Delta intake facilities on the Sacramento River. Bioenergetics modeling with a median predator density predicts a predation loss under Alternative 4 of less than 0.6% of the annual juvenile production (155,000 fall-run juveniles, 0.25% annual production; 25,000 late fall-run juveniles, 0.58% annual production) (Table 11-4-54).

**Table 11-4-54. Fall-Run and Late Fall-Run Chinook Salmon Juvenile Predation Loss at the Proposed North Delta Diversion (NDD) Intakes for Alternative 4 (Three Intakes)**

Striped Bass at NDD (Three Intakes)			Fall-Run Chinook		Late Fall-Run Chinook	
Density	Bass per 1,000 Feet of Intake	Total Number of Bass	Number Consumed (LLT)	Percentage of Annual Production	Number Consumed (LLT)	Percentage of Annual Production
Low	18	86	23,395	0.04%	3,795	0.09%
Median	119	571	154,665	0.25%	25,089	0.58%
High	219	1,051	284,636	0.46%	46,172	1.07%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

**NEPA Effects:** In conclusion, Alternative 4 would reduce overall entrainment losses of juvenile fall-run Chinook salmon and late fall-run Chinook salmon relative to NAA. The population benefit would be minor because entrainment losses affect less than 0.6% of annual juvenile index of abundance. Conditions under Scenario H4 would further reduce entrainment losses compared to Scenario H3 and Scenario H1. The effect of Alternative 4 would not be adverse.

**CEQA Conclusion:** Scenario H3 would substantially reduce entrainment at the south Delta facilities for fall-run (44% less) and late fall-run Chinook salmon (37% less) compared to Existing Conditions. Proportional losses of the juvenile population (juvenile index of abundance) would be slightly reduced from already-low levels (less than 0.25% average). Under Scenario H4, entrainment losses are expected to further decrease relative to Existing Conditions. Entrainment at the NBA would be minimal. Overall, impacts to fall-run and late fall-run Chinook salmon under Alternative 4 would be less than significant. No mitigation would be required.

1 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
2 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

3 In general, Alternative 4 would not affect the quantity and quality of spawning and egg incubation  
4 habitat for fall-/late fall-run Chinook salmon relative to the NAA.

5 **H3/ESO**

6 ***Sacramento River***

7 *Fall-Run*

8 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-  
9 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
10 *utilized in the Fish Analysis*). Flows under H3 would generally be greater than or similar to NAA,  
11 except during October in below normal years (8% lower) and all water year types during November  
12 (5% to 18% lower, depending on water year type).

13 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning  
14 and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir  
15 storage under H3 would be similar to storage under NAA in all water year types (Table 11-4-27).

16 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
17 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
18 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
19 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
20 between NAA and H3 in any month or water year type throughout the period.

21 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
22 increments was determined for each month during October through April and year of the 82-year  
23 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
24 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
25 between baselines and H3 in the highest level of concern across all months and all 82 modeled years  
26 are presented in Table 11-4-28. There would be 2 (4%) and 3 (23%) more years with a “red” and  
27 “orange” level of concern, respectively, under H3 that would not be biologically meaningful to fall-  
28 run Chinook salmon spawners and eggs, as this is a small proportion of the 82 year period.

29 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
30 October through April. Total degree-days under H3 would be 5% higher than those under NAA  
31 during October, 7% lower during April, and similar during remaining months (Table 11-4-29).

32 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
33 Sacramento River under H3 would be lower than or similar to mortality under NAA in all water year  
34 types including wet, above normal, and below normal years (5% to 9% greater, respectively, but  
35 absolute increase of 1% and 2% of fall-run population) (Table 11-4-55). These results indicate that  
36 H3 would have negligible effects on fall-run Chinook salmon egg mortality.

1 **Table 11-4-55. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**  
2 **Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	11 (110%)	1 (6%)
Above Normal	12 (111%)	1 (5%)
Below Normal	13 (124%)	2 (9%)
Dry	17 (116%)	0 (0%)
Critical	9 (31%)	-1 (-1%)
All	12 (89%)	1 (3%)

3  
4 SacEFT predicts that there would be a 54% increase in the percentage of years with good spawning  
5 habitat availability for fall-run Chinook salmon, measured as weighted usable area, under H3  
6 relative to NAA (Table 11-4-56). SacEFT predicts that there would be a 12% reduction in the  
7 percentage of years with good (lower) redd scour risk under H3 relative to NAA. SacEFT predicts  
8 that there would be no difference in the number of years with good egg incubation conditions  
9 between H3 and NAA. SacEFT predicts that there would be a 7% increase in redd dewatering risks  
10 under H3 relative to NAA.

11 **Table 11-4-56. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
12 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. H3	NAA vs. H3
Spawning WUA	6 (13%)	19 (54%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-25 (-27%)	0 (0%)
Redd Dewatering Risk	2 (7%)	2 (7%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-9 (-29%)	2 (10%)

WUA = Weighted Usable Area.

13  
14 *Late Fall-Run*

15 Sacramento River flows upstream of Red Bluff were examined for the February through May late  
16 fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model*  
17 *Results utilized in the Fish Analysis*). Flows under H3 would be up to 12% greater than flows under  
18 NAA during May, and similar during February through April.

19 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning  
20 and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir  
21 storage under H3 would be similar to storage under NAA in all water year types (Table 11-4-27).

22 The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the  
23 Sacramento River under H3 would be similar to or lower than mortality under NAA in all water  
24 years, including below normal water years in which, although there would be an 8% relative  
25 increase, the absolute increase would be <1% of the late fall-run population (Table 11-4-57).

1 **Table 11-4-57. Difference and Percent Difference in Percent Mortality of Late Fall-Run Chinook**  
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	4 (193%)	-0.3 (-5%)
Above Normal	4 (150%)	-1 (-13%)
Below Normal	4 (301%)	0.4 (8%)
Dry	4 (161%)	-1 (-7%)
Critical	3 (141%)	-0.1 (-2%)
All	4 (183%)	-0.3 (-4%)

3  
4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
5 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix  
6 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
8 between NAA and H3 in any month or water year type throughout the period.

9 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
10 increments was determined for each month during October through April and year of the 82-year  
11 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
12 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
13 between baselines and H3 in the highest level of concern across all months and all 82 modeled years  
14 are presented in Table 11-4-28. There would be 2 (4%) and 3 (23%) more years with a “red” and  
15 “orange” level of concern, respectively, under H3 that would not be biologically meaningful to late  
16 fall-run Chinook salmon spawners and eggs, as this is a small proportion of the 82 year period.

17 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
18 October through April. Total degree-days under H3 would be 5% higher than those under NAA  
19 during October, 7% lower during April, and similar during remaining months (Table 11-4-29).

20 SacEFT predicts that there would be no difference in the percentage of years with good spawning  
21 availability for late fall-run Chinook salmon, measured as weighted usable area, between NAA and  
22 H3 (Table 11-4-58). SacEFT predicts that there would be no difference in redd scour risk between  
23 NAA and H3. SacEFT predicts that there would be a negligible difference in the percentage of years  
24 with good (lower) egg incubation conditions and redd dewatering risk between H3 and NAA.

25 **Table 11-4-58. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
26 **for Late Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. H3	NAA vs. H3
Spawning WUA	-4 (-8%)	0 (0%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-3 (-5%)	2 (4%)
Juvenile Rearing WUA	-3 (-7%)	-21 (-33%)
Juvenile Stranding Risk	-30 (-42%)	-4 (-9%)

WUA = Weighted Usable Area.

27

1 **Clear Creek**

2 No water temperature modeling was conducted in Clear Creek.

3 **Fall-Run**

4 Clear Creek flows below Whiskeytown Reservoir were examined for the September through  
5 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*  
6 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be similar to flows under  
7 NAA with few exceptions.

8 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of  
9 flow reduction each month over the incubation period compared to the flow in September when  
10 spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during  
11 September through February under H3 would be similar to those under NAA in all water year types  
12 (Table 11-4-59).

13 **Table 11-4-59. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**  
14 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**  
15 **February Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

16  
17 **Feather River**

18 **Fall-Run**

19 Flows in the Feather River in the low-flow and high-flow channels were examined for the October  
20 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,  
21 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under H3 would  
22 be identical to those under NAA. Flows in the high-flow channel under H3 would generally be  
23 greater than those under NAA during October, and similar during November through January.

24 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
25 comparing the magnitude of flow reduction each month over the incubation period compared to the  
26 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during  
27 November through January were identical between H3 and NAA (Appendix 11C, *CALSIM II Model*  
28 *Results utilized in the Fish Analysis*). Therefore, there would be no effect of H3 on redd dewatering in  
29 the Feather River low-flow channel.

30 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
31 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October

through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and H3 in any month or water year type throughout the period at either location.

Effects of H3 on water temperature-related spawning and egg incubation conditions for fall-run Chinook salmon in the Feather River were analyzed by comparing the percent of months between October through April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold at Gridley (Table 11-4-60). In general, differences in the percent of months exceeding the threshold between NAA and H3 would be negligible (<5% on an absolute scale), although there would be a 6% reduction (absolute scale) in months exceeding the threshold by >3°F and >4°F during November.

**Table 11-4-60. Differences between Baseline and H3 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
October	2 (3%)	14 (16%)	27 (37%)	51 (124%)	63 (340%)
November	62 (1,667%)	41 (3,300%)	26 (NA)	12 (NA)	5 (NA)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	4 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	38 (517%)	27 (733%)	11 (900%)	7 (NA)	4 (NA)
April	20 (28%)	23 (41%)	40 (128%)	42 (243%)	27 (244%)
<b>NAA vs. H3</b>					
October	0 (0%)	0 (0%)	4 (4%)	2 (3%)	4 (5%)
November	4 (6%)	1 (3%)	-6 (-19%)	-6 (-33%)	-1 (-20%)
December	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (0%)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	1 (3%)	2 (9%)	1 (11%)	0 (0%)	0 (0%)
April	0 (0%)	0 (0%)	-2 (-3%)	0 (0%)	0 (0%)

NA = could not be calculated because the denominator was 0.

The effects of H3 on water temperature-related spawning and egg incubation conditions for fall-run Chinook salmon in the Feather River were also analyzed by comparing the total degree-months for months that exceed the 56°F NMFS threshold during the October through April fall-run Chinook salmon spawning and egg incubation period for all 82 years (Table 11-4-61). Combining all water year types, there would be no difference in total degree-months exceeded between NAA and H3. Large relative differences between NAA and H3 during December and February are mathematical artifacts due to small values of degree-months for NAA and would not translate into biologically meaningful effects on fall-run Chinook salmon. Results by water year type are generally similar to monthly results, except in dry water years during November (19% reduction). Overall, this method indicates that there would be no effect of H3 on temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the Feather River.

1 **Table 11-4-61. Differences between Baseline and H3 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**  
 3 **the Feather River at Gridley, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
October	Wet	98 (134%)	-4 (-2%)
	Above Normal	35 (80%)	-1 (-1%)
	Below Normal	49 (89%)	0 (0%)
	Dry	74 (140%)	3 (2%)
	Critical	47 (115%)	3 (4%)
	All	303 (114%)	1 (0.2%)
November	Wet	37 (NA)	0 (0%)
	Above Normal	19 (950%)	0 (0%)
	Below Normal	20 (2,000%)	-1 (-5%)
	Dry	25 (NA)	-6 (-19%)
	Critical	20 (2,000%)	2 (11%)
	All	121 (3,025%)	-5 (-4%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	-1 (-50%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	-1 (-50%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	1 (100%)
	Dry	1 (NA)	1 (NA)
	Critical	1 (NA)	-1 (-50%)
	All	4 (NA)	1 (33%)
March	Wet	5 (NA)	0 (0%)
	Above Normal	3 (300%)	1 (33%)
	Below Normal	23 (2,300%)	2 (9%)
	Dry	24 (600%)	1 (4%)
	Critical	17 (425%)	0 (0%)
	All	72 (720%)	4 (5%)
April	Wet	37 (264%)	-1 (-2%)
	Above Normal	27 (117%)	0 (0%)
	Below Normal	21 (53%)	-4 (-6%)
	Dry	42 (86%)	1 (1%)
	Critical	33 (114%)	2 (3%)
	All	160 (103%)	-2 (-1%)

NA = could not be calculated because the denominator was 0.

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
2 Feather River under H3 would be similar to or lower than mortality under NAA in all water years,  
3 including above normal water years in which, although there would be a 15% relative increase, the  
4 absolute increase would be 2% of the fall-run population (Table 11-4-62).

5 **Table 11-4-62. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**  
6 **Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	19 (1,391%)	0.2 (1%)
Above Normal	14 (1,269%)	2 (15%)
Below Normal	13 (759%)	0.4 (3%)
Dry	16 (718%)	-3 (-14%)
Critical	21 (427%)	-3 (-9%)
All	17 (806%)	-1 (-3%)

7

8 **American River**

9 *Fall-Run*

10 Flows in the American River at the confluence with the Sacramento River were examined during the  
11 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 8% lower than  
13 flows under NAA during November, and similar in the remaining three months.

14 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
15 comparing the magnitude of flow reduction each month over the incubation period compared to the  
16 flow in October when spawning is assumed to occur. The greatest reduction in American River flows  
17 during November through January under H3 would be 9% to 49% greater in magnitude than under  
18 NAA in above normal below normal, dry, and critical water years and 9% lower in magnitude than  
19 NAA in wet water years (Table 11-4-63).

20 **Table 11-4-63. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**  
21 **in Instream Flow in the American River at Nimbus Dam during the October through January**  
22 **Spawning and Egg Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-21 (-95%)	4 (9%)
Above Normal	-14 (-45%)	-4 (-9%)
Below Normal	-42 (-219%)	-15 (-32%)
Dry	-19 (-42%)	-22 (-49%)
Critical	8 (15%)	-4 (-10%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

23

1 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
 2 during the October through January fall-run Chinook salmon spawning and egg incubation period  
 3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
 4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
 5 temperature between NAA and H3 in any month or water year type throughout the period.

6 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
 7 Avenue Bridge was evaluated during November through April (Table 11-4-64). The percent of  
 8 months exceeding the threshold under H3 would generally be similar to the percent under NAA,  
 9 except for the >5.0°F exceedance category during November, which would be 5% lower (absolute  
 10 scale) under H3.

11 **Table 11-4-64. Differences between Baseline and H3 Scenarios in Percent of Months during the 82-**  
 12 **Year CALSIM Modeling Period during Which Water Temperatures in the American River at the**  
 13 **Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
November	47 (103%)	54 (200%)	58 (427%)	54 (2,200%)	35 (2,800%)
December	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	4 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	33 (270%)	25 (333%)	14 (550%)	11 (900%)	6 (NA)
April	25 (35%)	31 (50%)	35 (76%)	38 (119%)	32 (118%)
<b>NAA vs. H3</b>					
November	0 (0%)	-4 (-4%)	-2 (-3%)	0 (0%)	-5 (-12%)
December	1 (100%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (0%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
March	-4 (-8%)	0 (0%)	0 (0%)	0 (0%)	1 (25%)
April	-1 (-1%)	0 (0%)	0 (0%)	-1 (-2%)	2 (4%)

NA = could not be calculated because the denominator was 0.

14  
 15 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
 16 Avenue Bridge during November through April (Table 11-4-65). Total degree-months would be  
 17 similar between NAA and H3 for all months.

1 **Table 11-4-65. Differences between Baseline and H3 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**  
 3 **the American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
November	Wet	78 (312%)	-4 (-4%)
	Above Normal	35 (318%)	-1 (-2%)
	Below Normal	42 (525%)	-1 (-2%)
	Dry	49 (377%)	-2 (-3%)
	Critical	36 (225%)	-2 (-4%)
	All	240 (329%)	-10 (-3%)
December	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	3 (NA)	1 (50%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	4 (NA)	0 (0%)
	All	4 (NA)	0 (0%)
March	Wet	12 (600%)	0 (0%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	11 (367%)	0 (0%)
	Dry	24 (600%)	-1 (-3%)
	Critical	19 (190%)	-1 (-3%)
	All	75 (395%)	-2 (-2%)
April	Wet	58 (207%)	0 (0%)
	Above Normal	34 (155%)	0 (0%)
	Below Normal	40 (111%)	-1 (-1%)
	Dry	45 (59%)	0 (0%)
	Critical	40 (68%)	5 (5%)
	All	217 (98%)	4 (1%)

NA = could not be calculated because the denominator was 0.

4  
 5 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
 6 American River under H3 would be similar to mortality under NAA (Table 11-4-66).

1 **Table 11-4-66. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**  
2 **Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	24 (160%)	1 (1%)
Above Normal	22 (207%)	-1 (-2%)
Below Normal	21 (171%)	-1 (-3%)
Dry	16 (99%)	-0.2 (-1%)
Critical	9 (44%)	-1 (-2%)
All	19 (128%)	-0.3 (-1%)

3

4 **Stanislaus River**

5 *Fall-Run*

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
7 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
8 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would be similar to flows  
9 under NAA throughout the period.

10 Water temperatures throughout the Stanislaus River would be similar under NAA and H3  
11 throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*  
12 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

13 **San Joaquin River**

14 *Fall-Run*

15 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
16 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
17 *utilized in the Fish Analysis*). Flows under H3 would be similar to flows under NAA throughout the  
18 period.

19 Water temperature modeling was not conducted in the San Joaquin River.

20 **Mokelumne River**

21 *Fall-Run*

22 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
23 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
24 *utilized in the Fish Analysis*). Flows under H3 would be similar to flows under NAA throughout the  
25 period.

26 Water temperature modeling was not conducted in the Mokelumne River.

1 **H1/LOS**

2 ***Sacramento River***

3 *Fall-Run*

4 Flows in the Sacramento River upstream of Red Bluff during October through January under H1  
5 would generally be similar to flows under H3, except in November when flows would be up to 12%  
6 lower than under H3 depending on water year type (Appendix 11C, *CALSIM II Model Results utilized*  
7 *in the Fish Analysis*). This magnitude of flow reduction is not expected to have a biologically  
8 meaningful effect on fall-run Chinook salmon spawning and egg incubation habitat. September  
9 Shasta storage volume under H1 would generally be similar to September storage volume under H3  
10 (Table 11-4-27).

11 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
12 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
13 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
14 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
15 between NAA and H1 in any month or water year type throughout the period.

16 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
17 increments was determined for each month during October through April and year of the 82-year  
18 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
19 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
20 between baselines and H1 in the highest level of concern across all months and all 82 modeled years  
21 are presented in Table 11-4-67. There would be 6 (13%) fewer years with a “red” level of concern  
22 under H1 relative to NAA.

23 **Table 11-4-67. Differences between Baseline Scenarios and H1 and H4 Scenarios in the Number of**  
24 **Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**  
25 **Sacramento River at Red Bluff, October through April**

Level of Concern <sup>a</sup>	EXISTING CONDITIONS vs. H1		EXISTING CONDITIONS vs. H4	
	NAA vs. H1	NAA vs. H1	NAA vs. H4	NAA vs. H4
Red	30 (250%)	-6 (-13%)	38 (317%)	2 (4%)
Orange	15 (250%)	8 (62%)	9 (150%)	2 (15%)
Yellow	-2 (-15%)	-1 (-8%)	-5 (-38%)	-4 (-33%)
None	-43 (-84%)	-1 (-11%)	-42 (-82%)	0 (0%)

<sup>a</sup> For definitions of levels of concern, see Table 11-4-14.

26  
27 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
28 October through April. Total degree-days under H1 would be 5% higher than those under NAA  
29 during March, 10% lower during November, and similar during remaining months (Table 11-4-68).

1 **Table 11-4-68. Differences between Baseline Scenarios and H1 and H4 Scenarios in Total**  
 2 **Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above**  
 3 **56°F in the Sacramento River at Red Bluff, October through April**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
October	Wet	1,084 (422%)	-85 (-6%)	1,261 (491%)	92 (6%)
	Above Normal	452 (174%)	-25 (-3%)	498 (192%)	21 (3%)
	Below Normal	685 (328%)	-21 (-2%)	697 (333%)	-9 (-1%)
	Dry	1,018 (207%)	-53 (-3%)	1,044 (213%)	-27 (-2%)
	Critical	859 (143%)	-64 (-4%)	827 (138%)	-96 (-6%)
	All	4,098 (226%)	-248 (-4%)	4,327 (238%)	-19 (-0.3%)
November	Wet	72 (7,200%)	-18 (-20%)	94 (9,400%)	4 (4%)
	Above Normal	64 (NA)	3 (5%)	71 (NA)	10 (16%)
	Below Normal	41 (NA)	-7 (-15%)	45 (NA)	-3 (-6%)
	Dry	139 (1,738%)	-12 (-8%)	145 (1,813%)	-6 (-4%)
	Critical	98 (2,450%)	-12 (-11%)	88 (2,200%)	-22 (-19%)
	All	414 (3,185%)	-46 (-10%)	443 (3,408%)	-17 (-4%)
December	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	Wet	9 (NA)	0 (0%)	9 (NA)	0 (0%)
	Above Normal	6 (NA)	2 (50%)	5 (NA)	1 (25%)
	Below Normal	29 (322%)	8 (27%)	35 (389%)	14 (47%)
	Dry	63 (450%)	-1 (-1%)	65 (464%)	1 (1%)
	Critical	25 (2,500%)	-2 (-7%)	26 (2,600%)	-1 (-4%)
	All	132 (550%)	7 (5%)	140 (583%)	15 (10%)
April	Wet	259 (225%)	-2 (-1%)	262 (228%)	1 (0.3%)
	Above Normal	202 (144%)	-27 (-7%)	205 (146%)	-24 (-7%)
	Below Normal	230 (291%)	0 (0%)	255 (323%)	25 (8%)
	Dry	294 (158%)	-26 (-5%)	322 (173%)	2 (0.4%)
	Critical	135 (1,125%)	-16 (-10%)	131 (1,092%)	-20 (-12%)
	All	1,120 (211%)	-71 (-4%)	1,175 (221%)	-16 (-1%)

NA = could not be calculated because the denominator was 0.

1 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
2 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H1 would be similar to  
3 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
4 Overall, results for H1 would be similar to those for H3.

#### 5 *Late Fall-Run*

6 Flows in the Sacramento River upstream of Red Bluff during February through May under H1 would  
7 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*). September Shasta storage volume under H1 would generally be similar to September  
9 storage volume under H3 (Table 11-4-27).

10 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
11 February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix  
12 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
13 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
14 between NAA and H1 in any month or water year type throughout the period.

15 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
16 increments was determined for each month during October through April and year of the 82-year  
17 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
18 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
19 between baselines and H1 in the highest level of concern across all months and all 82 modeled years  
20 are presented in Table 11-4-67. There would be 6 (13%) fewer years with a “red” level of concern  
21 under H1 relative to NAA.

22 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
23 October through April. Total degree-days under H1 would be 5% higher than those under NAA  
24 during March, 10% lower during November, and similar during remaining months (Table 11-4-68).

25 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
26 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H1 would be similar to  
27 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
28 Overall, results for H1 would be similar to those for H3.

#### 29 **Clear Creek**

30 No water temperature modeling was conducted in Clear Creek.

#### 31 *Fall-Run*

32 Flows in Clear Creek flows below Whiskeytown Reservoir during October through January would  
33 generally be similar between H1 and H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
34 *Analysis*). As a result, no additional flow analyses were conducted for H1. Overall, results for H1  
35 would be similar to those for H3.

1       **Feather River**

2       *Fall-Run*

3       Flows in the Feather River low-flow and high-flow channels during October through January would  
4       generally be similar between H1 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish*  
5       *Analysis*).

6       Differences in the percent of months exceeding the 56°F NMFS threshold between NAA and H1  
7       would be negligible (<5% on an absolute scale) during all months except October, November, March,  
8       and April, in which the percent of months under H1 would be similar to or up to 21% lower than  
9       those under NAA (Table 11-4-69).

1 **Table 11-4-69. Differences between Baselines and H1 and H4 Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
October	2 (3%)	12 (14%)	21 (29%)	38 (94%)	53 (287%)
November	37 (1,000%)	25 (2,000%)	12 (NA)	6 (NA)	4 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	26 (350%)	15 (400%)	6 (500%)	5 (NA)	2 (NA)
April	12 (18%)	19 (33%)	33 (108%)	36 (207%)	21 (189%)
<b>NAA vs. H1</b>					
October	0 (0%)	-1 (-1%)	-2 (-3%)	-10 (-11%)	-6 (-8%)
November	-21 (-34%)	-15 (-36%)	-20 (-62%)	-12 (-67%)	-2 (-40%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-11 (-25%)	-10 (-35%)	-4 (-33%)	-2 (-33%)	-1 (-33%)
April	-7 (-8%)	-5 (-6%)	-9 (-12%)	-6 (-10%)	-6 (-16%)
<b>EXISTING CONDITIONS vs. H4</b>					
October	2 (3%)	12 (14%)	22 (31%)	42 (103%)	54 (293%)
November	43 (1,167%)	31 (2,500%)	21 (NA)	11 (NA)	7 (NA)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	25 (333%)	14 (367%)	7 (600%)	5 (NA)	2 (NA)
April	-5 (-7%)	1 (2%)	21 (68%)	23 (136%)	15 (133%)
<b>NAA vs. H4</b>					
October	0 (0%)	-1 (-1%)	-1 (-1%)	-6 (-7%)	-5 (-6%)
November	-15 (-24%)	-9 (-21%)	-11 (-35%)	-7 (-40%)	1 (20%)
December	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-12 (-28%)	-11 (-39%)	-2 (-22%)	-2 (-33%)	-1 (-33%)
April	-25 (-27%)	-22 (-28%)	-21 (-29%)	-19 (-31%)	-12 (-32%)

NA = could not be calculated because the denominator was 0.

4 Combining all water year types, there would be no difference between NAA and H1 in total degree-  
 5 months exceeded in all months except October and November, during which degree-months would  
 6 be lower by 9% and 28%, respectively (Table 11-4-70). Large relative differences between NAA and  
 7 H1 during some months are due to small values of degree-months for NAA and would not translate  
 8 into biologically meaningful effects on fall-run Chinook salmon. Results by water year type are  
 9 generally similar to monthly results. Overall, this method indicates that there would be benefits of  
 10 H1 on temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the  
 11 Feather River.

1  
2  
3

**Table 11-4-70. Differences between Baselines and H1 and H4 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
October	Wet	78 (107%)	-24 (-14%)	106 (145%)	4 (2%)
	Above Normal	30 (68%)	-6 (-8%)	44 (100%)	8 (10%)
	Below Normal	44 (80%)	-5 (-5%)	55 (100%)	6 (6%)
	Dry	60 (113%)	-11 (-9%)	70 (132%)	-1 (-1%)
	Critical	42 (102%)	-2 (-2%)	33 (80%)	-11 (-13%)
	All	253 (95%)	-49 (-9%)	309 (116%)	7 (1%)
November	Wet	24 (NA)	-13 (-35%)	34 (NA)	-3 (-8%)
	Above Normal	16 (800%)	-3 (-14%)	23 (1,150%)	4 (19%)
	Below Normal	14 (1,400%)	-7 (-32%)	22 (2,200%)	1 (5%)
	Dry	19 (NA)	-12 (-39%)	24 (NA)	-7 (-23%)
	Critical	17 (1,700%)	-1 (-5%)	13 (1,300%)	-5 (-26%)
	All	90 (2,250%)	-36 (-28%)	116 (2,900%)	-10 (-8%)
December	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-2 (-100%)	1 (NA)	-1 (-50%)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	-2 (-100%)	1 (NA)	-1 (-50%)
January	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-1 (-100%)	0 (NA)	-1 (-100%)
	Dry	1 (NA)	1 (NA)	0 (NA)	0 (NA)
	Critical	2 (NA)	0 (0%)	2 (NA)	0 (0%)
	All	2 (NA)	-1 (-33%)	2 (NA)	-1 (-33%)
March	Wet	5 (NA)	0 (0%)	6 (NA)	1 (20%)
	Above Normal	0 (0%)	-2 (-67%)	1 (100%)	-1 (-33%)
	Below Normal	19 (1,900%)	-2 (-9%)	17 (1,700%)	-4 (-18%)
	Dry	22 (550%)	-1 (-4%)	24 (600%)	1 (4%)
	Critical	16 (400%)	-1 (-5%)	17 (425%)	0 (0%)
	All	63 (630%)	-5 (-6%)	64 (640%)	-4 (-5%)
April	Wet	38 (271%)	0 (0%)	19 (136%)	-19 (-37%)
	Above Normal	26 (113%)	-1 (-2%)	7 (30%)	-20 (-40%)
	Below Normal	22 (55%)	-3 (-5%)	1 (3%)	-24 (-37%)
	Dry	41 (84%)	0 (0%)	42 (86%)	1 (1%)
	Critical	32 (110%)	1 (2%)	33 (114%)	2 (3%)
	All	159 (103%)	-3 (-1%)	102 (66%)	-60 (-19%)

NA = could not be calculated because the denominator was 0.

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1 Due to similar flows and water temperatures between H1 and H3, results under H1 would be similar  
2 to results for analyses under H3.

3 ***American River***

4 ***Fall-Run***

5 Flows in the American River at the confluence with the Sacramento River during October through  
6 January would generally be similar between H1 and H3 with few exceptions that would not be  
7 biologically meaningful (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
9 during the October through January fall-run Chinook salmon spawning and egg incubation period  
10 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
11 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
12 temperature between NAA and H1 in any month or water year type throughout the period.

13 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
14 Avenue Bridge was evaluated during November through April (Table 11-4-71). The percent of  
15 months exceeding the threshold under H1 would similar to or up to 11% lower (absolute scale) than  
16 the percent under NAA.

1 **Table 11-4-71. Differences between Baseline Scenarios and H1 and H4 Scenarios in Percent of**  
 2 **Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the**  
 3 **American River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
November	26 (57%)	23 (86%)	22 (164%)	19 (750%)	11 (900%)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	2 (20%)	4 (50%)	6 (250%)	2 (200%)	1 (NA)
April	11 (16%)	7 (12%)	10 (22%)	10 (31%)	2 (9%)
<b>NAA vs. H1</b>					
November	-2 (-3%)	-10 (-12%)	-6 (-8%)	-11 (-20%)	-9 (-21%)
December	1 (100%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-20%)	-10 (-31%)	-1 (-8%)	-2 (-20%)	0 (0%)
April	-1 (-1%)	-6 (-7%)	-7 (-9%)	-9 (-12%)	-5 (-9%)
<b>EXISTING CONDITIONS vs. H4</b>					
November	43 (95%)	51 (186%)	49 (364%)	46 (1,850%)	32 (2,600%)
December	1 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (220%)	17 (233%)	11 (450%)	10 (800%)	4 (NA)
April	26 (37%)	25 (40%)	27 (59%)	30 (92%)	25 (91%)
<b>NAA vs. H4</b>					
November	-4 (-4%)	-7 (-9%)	-11 (-15%)	-9 (-15%)	-7 (-18%)
December	0 (0%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-20%)	-7 (-23%)	-2 (-15%)	-1 (-10%)	-1 (-25%)
April	0 (0%)	-6 (-7%)	-7 (-9%)	-10 (-14%)	-5 (-9%)
NA = could not be calculated because the denominator was 0.					

4  
 5 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
 6 Avenue Bridge during November through April (Table 11-4-72). Total degree-months would be  
 7 similar between NAA and H1 for all months.

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**Table 11-4-72. Differences between Baseline Scenarios and H1 and H4 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. H1	NAA vs. H1	EXISTING CONDITIONS vs. H4	NAA vs. H4
November	Wet	78 (312%)	-4 (-4%)	77 (308%)	-5 (-5%)
	Above Normal	33 (300%)	-3 (-6%)	32 (291%)	-4 (-9%)
	Below Normal	43 (538%)	0 (0%)	43 (538%)	0 (0%)
	Dry	46 (354%)	-5 (-8%)	50 (385%)	-1 (-2%)
	Critical	38 (238%)	0 (0%)	38 (238%)	0 (0%)
	All	238 (326%)	-12 (-4%)	240 (329%)	-10 (-3%)
December	Wet	1 (NA)	1 (NA)	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	3 (NA)	1 (50%)	3 (NA)	1 (50%)
January	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	3 (NA)	-1 (-25%)	3 (NA)	-1 (-25%)
	All	3 (NA)	-1 (-25%)	3 (NA)	-1 (-25%)
March	Wet	10 (500%)	-2 (-14%)	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)	9 (NA)	0 (0%)
	Below Normal	10 (333%)	-1 (-7%)	11 (367%)	0 (0%)
	Dry	24 (600%)	-1 (-3%)	25 (625%)	0 (0%)
	Critical	20 (200%)	0 (0%)	20 (200%)	0 (0%)
	All	73 (384%)	-4 (-4%)	75 (395%)	-2 (-2%)
April	Wet	57 (204%)	-1 (-1%)	57 (204%)	-1 (-1%)
	Above Normal	33 (150%)	-1 (-2%)	33 (150%)	-1 (-2%)
	Below Normal	39 (108%)	-2 (-3%)	40 (111%)	-1 (-1%)
	Dry	45 (59%)	0 (0%)	45 (59%)	0 (0%)
	Critical	36 (61%)	1 (1%)	35 (59%)	0 (0%)
	All	210 (95%)	-3 (-1%)	210 (95%)	-3 (-1%)

NA = could not be calculated because the denominator was 0.

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Due to similar flows and water temperatures between H1 and H3, results for additional analyses (e.g., risk of redd dewatering, Reclamation egg mortality model) under H1 would be similar to results for analyses under H3. As a result, these additional analyses were not conducted for H1. Overall, results for H1 would be similar to those for H3.

1       **Stanislaus River**

2       *Fall-Run*

3       Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
4       October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
5       11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would be similar to flows  
6       under NAA throughout the period.

7       Water temperatures throughout the Stanislaus River would be similar under NAA and H1  
8       throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*  
9       *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

10       **San Joaquin River**

11       *Fall-Run*

12       Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
13       Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
14       *utilized in the Fish Analysis*). Flows under H1 would be similar to flows under NAA throughout the  
15       period.

16       Water temperature modeling was not conducted in the San Joaquin River.

17       **Mokelumne River**

18       *Fall-Run*

19       Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
20       Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
21       *utilized in the Fish Analysis*). Flows under H1 would be similar to flows under NAA throughout the  
22       period.

23       Water temperature modeling was not conducted in the Mokelumne River.

24       **H4/HOS**

25       **Sacramento River**

26       *Fall-Run*

27       Flows in the Sacramento River upstream of Red Bluff during October through January under H4  
28       would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
29       *Fish Analysis*). September Shasta storage volume under H4 would generally be similar to September  
30       storage volume under H3 (Table 11-4-27).

31       Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
32       October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
33       11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
34       *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
35       between NAA and H4 in any month or water year type throughout the period.

1 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
2 increments was determined for each month during October through April and year of the 82-year  
3 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
4 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
5 between baselines and H4 in the highest level of concern across all months and all 82 modeled years  
6 are presented in Table 11-4-67. There would be 2 (4%) and 2 (15%) more years with a “red” and  
7 orange level of concern, respectively, under H1 relative to NAA. It is not likely that these differences  
8 would be biologically meaningful.

9 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
10 October through April. Total degree-days under H4 would be 10% higher than those under NAA  
11 during March and similar during remaining months (Table 11-4-68).

12 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
13 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H4 would be similar to  
14 results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
15 Overall, results for H4 would be similar to those for H3.

#### 16 *Late Fall-Run*

17 Flows in the Sacramento River upstream of Red Bluff during February through May under H4 would  
18 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
19 *Analysis*). September Shasta storage volume under H4 would generally be similar to September  
20 storage volume under H3 (Table 11-4-27).

21 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
22 February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix  
23 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
24 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
25 between NAA and H4 in any month or water year type throughout the period.

26 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
27 increments was determined for each month during October through April and year of the 82-year  
28 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
29 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
30 between baselines and H4 in the highest level of concern across all months and all 82 modeled years  
31 are presented in Table 11-4-67. There would be 2 (4%) and 2 (15%) more years with a “red” and  
32 orange level of concern, respectively, under H1 relative to NAA. It is not likely that these differences  
33 would be biologically meaningful.

34 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
35 October through April. Total degree-days under H4 would be 10% higher than those under NAA  
36 during March and similar during remaining months (Table 11-4-68).

37 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
38 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H4 would be similar to  
39 results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
40 Overall, results for H4 would be similar to those for H3.

1       **Clear Creek**

2       No water temperature modeling was conducted in Clear Creek.

3       *Fall-Run*

4       Flows in Clear Creek flows below Whiskeytown Reservoir during October through January would  
5       generally be similar between H4 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish*  
6       *Analysis*). As a result, no additional flow analyses were conducted for H4. Overall, results for H4  
7       would be similar to those for H3.

8       **Feather River**

9       *Fall-Run*

10       Flows in the Feather River low-flow channel during October through January would be similar  
11       between H4 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
12       H4 in the high-flow channel would generally be similar to those under H3, except during October, in  
13       which flows would be up to 27% lower depending on water year type. Because flow reductions  
14       would occur in only one month, they are not expected to have a biologically meaningful effect on  
15       fall-run Chinook salmon spawning and egg incubation.

16       Differences in the percent of months exceeding the 56°F NMFS threshold between NAA and H4  
17       would be negligible (<5% on an absolute scale) during all months except October, November, March,  
18       and April, in which the percent of months under H4 would be similar to or up to 25% lower than  
19       those under NAA (Table 11-4-69). This method indicates that there would be benefits of H1 on  
20       temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the Feather  
21       River.

22       Combining all water year types, there would be no difference between NAA and H1 in total degree-  
23       months exceeded in all months except November, March, and April, during which degree-months  
24       would be lower by 8%, 5%, and 19%, respectively (Table 11-4-70). Large relative differences  
25       between NAA and H1 during some months are mathematical artifacts due to small values of degree-  
26       months for NAA and would not translate into biologically meaningful effects on fall-run Chinook  
27       salmon. Splitting monthly results into water year types yields highly variable outcomes. There  
28       would be small increases and decreases in degree-months under H4 relative to NAA depending on  
29       month and water year type. Overall, this method indicates that there would be benefits of H1 on  
30       temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the Feather  
31       River.

32       Due to generally similar flows and water temperatures between H4 and H3, results under H4 would  
33       be similar to results for analyses under H3.

34       **American River**

35       *Fall-Run*

36       Flows in the American River at the confluence with the Sacramento River during October through  
37       January would generally be similar between H4 and H3, except during October, in which flows  
38       would be 6% to 13% lower depending on water year type (*Appendix 11C, CALSIM II Model Results*  
39       *utilized in the Fish Analysis*). Because flow reductions would occur in only one month and would be

1 low in magnitude, they are not expected to have a biologically meaningful effect on fall-run Chinook  
2 salmon spawning and egg incubation.

3 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
4 during the October through January fall-run Chinook salmon spawning and egg incubation period  
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
6 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
7 temperature between NAA and H4 in any month or water year type throughout the period.

8 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
9 Avenue Bridge was evaluated during November through April (Table 11-4-71). The percent of  
10 months exceeding the threshold under H4 would similar to or up to 11% lower (absolute scale) than  
11 the percent under NAA.

12 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
13 Avenue Bridge during November through April (Table 11-4-72). Total degree-months would be  
14 similar between NAA and H4 for all months.

15 Due to generally similar flows and water temperatures between H4 and H3, results for additional  
16 analyses (e.g., risk of redd dewatering, Reclamation egg mortality model) under H4 would be similar  
17 to results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
18 Overall, results for H4 would be similar to those for H3.

### 19 ***Stanislaus River***

#### 20 *Fall-Run*

21 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
22 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
23 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would be similar to flows  
24 under NAA throughout the period.

25 Water temperatures throughout the Stanislaus River would be similar under NAA and H4  
26 throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*  
27 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

### 28 ***San Joaquin River***

#### 29 *Fall-Run*

30 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
31 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
32 *utilized in the Fish Analysis*). Flows under H4 would be similar to flows under NAA throughout the  
33 period.

34 Water temperature modeling was not conducted in the San Joaquin River.

### 35 ***Mokelumne River***

#### 36 *Fall-Run*

37 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
38 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*

1 *utilized in the Fish Analysis*). Flows under H4 would be similar to flows under NAA throughout the  
2 period.

3 Water temperature modeling was not conducted in the Mokelumne River.

4 **NEPA Effects:** Collectively, it is concluded that the effect is not adverse because habitat conditions  
5 are not substantially reduced. There are no reductions in flows under Alternative 4 or increases in  
6 temperatures that would translate into biologically meaningful effects on fall-/late fall-run Chinook  
7 salmon. In all rivers, there are no large or consistent differences relative to NAA. Biological modeling  
8 results also indicate that Alternative 4 would not substantially affect fall-/late fall-run Chinook  
9 salmon spawning and egg incubation habitat relative to the NEPA point of comparison. There would  
10 generally be no differences among scenarios.

11 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
12 and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon would not  
13 be affected relative to the CEQA baseline.

### 14 **H3/ESO**

#### 15 **Sacramento River**

##### 16 *Fall-Run*

17 Flows in the Sacramento River upstream of Red Bluff were examined during the October through  
18 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*). Flows under H3 would be up to 14% lower than flows  
20 under Existing Conditions during November, and similar during the remaining three months.

21 Shasta storage volume at the end of September would be 15% to 33% lower under H3 relative to  
22 Existing Conditions (Table 11-4-27).

23 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
24 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
25 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
26 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
27 between Existing Conditions and H3 during the period, except during October, in which  
28 temperatures would be 6% higher under H3.

29 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
30 increments was determined for each month during October through April and year of the 82-year  
31 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
32 threshold were further H3 in the highest level of concern across all months and all 82 modeled years  
33 are presented in Table 11-4-28. There would be 38 (317%) and 10 (167%) more years with “red”  
34 and “orange” levels of concern under H3 than under Existing Conditions.

35 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
36 October through April. Total degree-days under H3 would be 203% to 3,662% higher than those  
37 under Existing Conditions during October, November, March, and April, and similar during  
38 December through February (Table 11-4-29).

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
2 Sacramento River under H3 would be 31% to 124% greater than mortality under Existing  
3 Conditions (Table 11-4-55).

4 SacEFT predicts that there would be a 13% increase in the percentage of years with good spawning  
5 availability, measured as weighted usable area, under H3 relative to Existing Conditions (Table 11-  
6 4-56). SacEFT predicts that there would be a 5% reduction in the percentage of years with good  
7 (lower) redd scour risk under H3 relative to Existing Conditions. SacEFT predicts that there would  
8 be a 27% decrease in the percentage of years with good (lower) egg incubation conditions under H3  
9 relative to Existing Conditions. SacEFT predicts that there would be a 7% increase in the percentage  
10 of years with good (lower) redd dewatering risk under H3 relative to Existing Conditions.

#### 11 *Late Fall-Run*

12 Flows in the Sacramento River upstream of Red Bluff were examined during the February through  
13 May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*  
14 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 14% greater  
15 than flows under Existing Conditions during May, and similar during the other three months.

16 Storage volume at the end of September would be 15% to 33% lower under H3 relative to Existing  
17 Conditions (Table 11-4-27).

18 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
19 February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix  
20 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
21 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
22 between Existing Conditions and H3 in any month or water year type throughout the period.

23 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
24 increments was determined for each month during October through April and year of the 82-year  
25 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
26 threshold were further H3 in the highest level of concern across all months and all 82 modeled years  
27 are presented in Table 11-4-28. There would be 38 (317%) and 10 (167%) more years with “red”  
28 and “orange” levels of concern under H3 than under Existing Conditions.

29 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
30 October through April. Total degree-days under H3 would be 203% to 3,662% higher than those  
31 under Existing Conditions during October, November, March, and April, and similar during  
32 December through February (Table 11-4-29).

33 The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the  
34 Sacramento River under H3 would be 141% to 301% greater than mortality under Existing  
35 Conditions (Table 11-4-57). However, absolute differences in the percent of the late-fall population  
36 subject to mortality would be minimal in all water years.

37 SacEFT predicts that there would be a 8% decrease in the percentage of years with good spawning  
38 availability, measured as weighted usable area, under H3 relative to Existing Conditions (Table 11-  
39 4-58). SacEFT predicts that there would be a 7% decrease in the percentage of years with good  
40 (lower) redd scour risk under H3 relative to Existing Conditions. SacEFT predicts that there would  
41 be no difference in the percentage of years with good (lower) egg incubation conditions under H3

1 relative to Existing Conditions. SacEFT predicts that there would be a 5% decrease in the percentage  
2 of years with good (lower) redd dewatering risk under H3 relative to Existing Conditions.

### 3 **Clear Creek**

4 No water temperature modeling was conducted in Clear Creek.

#### 5 *Fall-Run*

6 Flows in Clear Creek below Whiskeytown Reservoir under H3 during the September through  
7 February fall-run spawning and egg incubation period would generally be similar to flows under  
8 Existing Conditions with few exceptions.

9 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of  
10 flow reduction each month over the incubation period compared to the flow in September when  
11 spawning occurred. Clear Creek flows would be reduced during October through February under  
12 H3) in above normal, dry, and critical water years and increased in below normal water years (Table  
13 11-4-59).

### 14 **Feather River**

#### 15 *Fall-Run*

16 Flows in the Feather River low-flow channel during October through January under H3 would be  
17 identical to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the*  
18 *Fish Analysis*). Flows in the high-flow channel under H3 would generally be up to 46% lower than  
19 flows under Existing Conditions during December and January, up to 33% greater during October,  
20 and similar during November.

21 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by  
22 comparing the magnitude of flow reduction each month over the incubation period compared to the  
23 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were  
24 identical between H3 and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the*  
25 *Fish Analysis*). Therefore, there would be no effect of Alternative 4 on redd dewatering in the Feather  
26 River low-flow channel. Mean monthly water temperatures in the Feather River above Thermalito  
27 Afterbay (low-flow channel) and below Thermalito Afterbay (high-flow channel) were examined  
28 during the October through January fall-run Chinook salmon spawning and egg incubation period  
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
30 *utilized in the Fish Analysis*). Mean monthly water temperatures would be under H3 relative to  
31 Existing Conditions by 7% to 10% higher in the low-flow channel and 6% to 8% higher in the high-  
32 flow channel depending on month.

33 Effects of H3 on water temperature-related spawning and egg incubation conditions for fall-run  
34 Chinook salmon in the Feather River were analyzed by comparing the percent of months between  
35 October through April over the 82-year CALSIM modeling period that exceed a 56°F temperature  
36 threshold at Gridley (Table 11-4-60). In general, the percent of months exceeding the threshold  
37 under H3 would be up to 63% greater than the percent under Existing Conditions in all months  
38 except December, January, and February, during which the percent would not differ from Existing  
39 Conditions. This comparison includes the effects of climate change.

1 The effects of H3 on water temperature-related spawning and egg incubation conditions for fall-run  
2 Chinook salmon in the Feather River were also analyzed by comparing the total degree-months for  
3 months that exceeded the 56°F NMFS threshold during the October through April fall-run Chinook  
4 salmon spawning and egg incubation period for all 82 years (Table 11-4-61). In general, total  
5 degree-months under H3 would be up to 303 degree-months (114%) greater than under Existing  
6 Conditions in all months except December, January, and February, during which degree-months  
7 would not differ from Existing Conditions. This comparison includes the effects of climate change.  
8 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
9 Feather River under H3 would be 427% to 1,391% greater than mortality under Existing Conditions  
10 (Table 11-4-62).

### 11 ***American River***

#### 12 *Fall-Run*

13 Flows in the American River at the confluence with the Sacramento River under H3 would generally  
14 be up to 33% lower than flows under Existing Conditions during November through January, but  
15 generally similar to flows under Existing Conditions during October.

16 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by  
17 comparing the magnitude of flow reduction each month over the incubation period compared to the  
18 flow in October when spawning is assumed to occur. The greatest monthly reduction in American  
19 River flows during November through January under H3 would be 45% to 219% greater magnitude  
20 than those under Existing Conditions in all years except critical (15% lower magnitude)(Table 11-4-  
21 63).

22 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
23 during the October through January fall-run Chinook salmon spawning and egg incubation period  
24 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
25 *utilized in the Fish Analysis*). Mean monthly temperatures under H3 would be 5% to 12% greater  
26 than those under Existing Conditions depending on month.

27 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
28 Avenue Bridge was evaluated during November through April (Table 11-4-64). The percent of  
29 months exceeding the threshold under H3 would be up to 58% greater (absolute scale) than the  
30 percent under Existing Conditions during November, March, and April and similar to the percent  
31 under Existing Conditions during December through February.

32 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
33 Avenue Bridge during November through April (Table 11-4-65). Total degree-months under H3  
34 would be 98% to 395% greater than total degree-months under Existing Conditions during  
35 November, March and April and similar to total degree months under Existing Conditions during  
36 December through February.

37 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the  
38 American River under H3 would be 44% to 207% greater than mortality under Existing Conditions  
39 (Table 11-4-66).

1 **Stanislaus River**

2 *Fall-Run*

3 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
4 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
5 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H3 would be up 6% to 7%  
6 lower than those under Existing Conditions in all months except January, in which flows would be  
7 similar between Existing Conditions and H3.

8 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were  
9 examined during the October through January fall-run spawning and egg incubation period  
10 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
11 *utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would not be different  
12 from those under Existing Conditions during October, but 6% higher during November through  
13 January.

14 **San Joaquin River**

15 *Fall-Run*

16 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
17 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
18 *utilized in the Fish Analysis*). Flows under H3 would be similar in all months of the period except  
19 January, in which flows would be 5% greater under H3.

20 Water temperature modeling was not conducted in the San Joaquin River.

21 **Mokelumne River**

22 *Fall-Run*

23 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
24 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
25 *utilized in the Fish Analysis*). Flows under H3 would be up to 14% lower than flows under Existing  
26 Conditions during October and November, up to 15% greater than flows under Existing Conditions  
27 during December, and similar to flows under Existing Conditions during January.

28 Water temperature modeling was not conducted in the Mokelumne River.

29 **H1/LOS**

30 **Sacramento River**

31 *Fall-Run*

32 Flows in the Sacramento River upstream of Red Bluff during October through January under H1  
33 would generally be similar to flows under H3, except in November when flows would be up to 12%  
34 lower than under H3 depending on water year type (Appendix 11C, *CALSIM II Model Results utilized*  
35 *in the Fish Analysis*). This magnitude of flow reduction is not expected to have a biologically  
36 meaningful effect on fall-run Chinook salmon spawning and egg incubation habitat. September  
37 Shasta storage volume under H1 would generally be similar to September storage volume under H3  
38 (Table 11-4-27).

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
2 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
3 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
4 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
5 between Existing Conditions and H1 during the period, except during October, in which  
6 temperatures would be 5% higher under H1.

7 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
8 increments was determined for each month during October through April and year of the 82-year  
9 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
10 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
11 between baselines and H1 in the highest level of concern across all months and all 82 modeled years  
12 are presented in Table 11-4-67. There would be 250% increases in the number of years with “red”  
13 and “orange” levels of concern under H1 relative to Existing Conditions.

14 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
15 October through April. Total degree-days under H1 would be 211% to 3,185% higher than those  
16 under Existing Conditions during October, November, March, and April, and similar during  
17 December through February (Table 11-4-68).

18 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
19 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H1 would be similar to  
20 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
21 Overall, results for H1 would be similar to those for H3.

#### 22 *Late Fall-Run*

23 Flows in the Sacramento River upstream of Red Bluff during February through May under H1 would  
24 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
25 *Analysis*).

26 September Shasta storage volume under H1 would generally be similar to September storage  
27 volume under H3 (Table 11-4-27).

28 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
29 February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix  
30 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
31 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
32 between Existing Conditions and H1 in any month or water year type throughout the period.

33 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
34 increments was determined for each month during October through April and year of the 82-year  
35 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
36 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
37 between baselines and H1 in the highest level of concern across all months and all 82 modeled years  
38 are presented in Table 11-4-67. There would be 250% increases in the number of years with “red”  
39 and “orange” levels of concern under H1 relative to Existing Conditions.

40 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
41 October through April. Total degree-days under H1 would be 211% to 3,185% higher than those

1 under Existing Conditions during October, November, March, and April, and similar during  
2 December through February (Table 11-4-68).

3 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
4 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H1 would be similar to  
5 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
6 Overall, results for H1 would be similar to those for H3.

#### 7 **Clear Creek**

8 No water temperature modeling was conducted in Clear Creek.

#### 9 *Fall-Run*

10 Flows in Clear Creek flows below Whiskeytown Reservoir during October through January would  
11 generally be similar between H1 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish*  
12 *Analysis*). As a result, no additional flow analyses were conducted for H1. Overall, results for H1  
13 would be similar to those for H3.

#### 14 **Feather River**

#### 15 *Fall-Run*

16 Flows in the Feather River low-flow and high-flow channels during October through January would  
17 generally be similar between H1 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish*  
18 *Analysis*).

19 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
20 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October  
21 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,  
22 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
23 *Fish Analysis*). Mean monthly water temperatures would be under H1 relative to Existing Conditions  
24 by 5% to 9% higher in the low-flow channel and 6% to 8% higher in the high-flow channel  
25 depending on month.

26 Differences in the percent of months exceeding the 56°F NMFS threshold between Existing  
27 Conditions and H1 would be negligible (<5% on an absolute scale) during all months except October,  
28 November, March, and April, in which the percent of months under H1 would be similar to or up to  
29 53% lower (absolute scale) than those under Existing Conditions (Table 11-4-60). This comparison  
30 includes the effects of climate change.

31 Combining all water year types, there would be no difference between Existing Conditions and H1 in  
32 total degree-months exceeded in all months except October, November, March, and April during  
33 which degree-months under H1 would be greater by up to 253 degree-months (95%) (Table 11-4-  
34 61). This comparison includes the effects of climate change.

35 Due to generally similar flows and water temperatures between H1 and H3, results under H1 would  
36 be similar to results for analyses under H3.

1 **American River**

2 *Fall-Run*

3 Flows in the American River at the confluence with the Sacramento River during October through  
4 January would generally be similar between H1 and H3 with few exceptions that would not be  
5 biologically meaningful (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
7 during the October through January fall-run Chinook salmon spawning and egg incubation period  
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
9 *utilized in the Fish Analysis*). Mean monthly temperatures under H1 would be 5% to 12% greater  
10 than those under Existing Conditions depending on month.

11 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
12 Avenue Bridge was evaluated during November through April (Table 11-4-71). The percent of  
13 months exceeding the threshold under H1 would be up to 26% greater (absolute scale) than the  
14 percent under Existing Conditions during November, March, and April and similar to the percent  
15 under Existing Conditions during December through February.

16 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
17 Avenue Bridge during November through April (Table 11-4-72). Total degree-months under H1  
18 would be 95% to 384% greater than total degree-months under Existing Conditions during  
19 November, March and April and similar to total degree months under Existing Conditions during  
20 December through February.

21 Due to similar flows and water temperatures between H1 and H3, results for additional analyses  
22 (e.g., risk of redd dewatering, Reclamation egg mortality model) under H1 would be similar to  
23 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
24 Overall, results for H1 would be similar to those for H3.

25 **Stanislaus River**

26 *Fall-Run*

27 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
28 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
29 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H1 would be 6% to 7% lower  
30 than those under Existing Conditions in all months except January, in which flows would be similar  
31 between Existing Conditions and H1.

32 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were  
33 examined during the October through January fall-run spawning and egg incubation period  
34 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
35 *utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would not be different  
36 from those under Existing Conditions during October, but 6% higher during November through  
37 January.

1 **San Joaquin River**

2 *Fall-Run*

3 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
4 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
5 *utilized in the Fish Analysis*). Flows under H1 would be 5% lower than flows under Existing Conditions  
6 during October, similar during November and December, and 5% greater during January.

7 Water temperature modeling was not conducted in the San Joaquin River.

8 **Mokelumne River**

9 *Fall-Run*

10 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
11 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
12 *utilized in the Fish Analysis*). Flows under H1 would be up to 14% lower than flows under Existing  
13 Conditions during October and November and up to 18% greater than flows under Existing  
14 Conditions during December and January.

15 Water temperature modeling was not conducted in the Mokelumne River.

16 **H4/HOS**

17 **Sacramento River**

18 *Fall-Run*

19 Flows in the Sacramento River upstream of Red Bluff during October through January under H4  
20 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
21 *Fish Analysis*). September Shasta storage volume under H4 would generally be similar to September  
22 storage volume under H3 (Table 11-4-27).

23 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
24 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix  
25 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
26 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
27 between Existing Conditions and H4 during the period, except during October, in which  
28 temperatures would be 5% higher under H4.

29 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
30 increments was determined for each month during October through April and year of the 82-year  
31 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
32 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
33 between baselines and H1 in the highest level of concern across all months and all 82 modeled years  
34 are presented in Table 11-4-67. There would be 317% and 150% increases in the number of years  
35 with “red” and “orange” levels of concern, respectively, under H1 relative to Existing Conditions.

36 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
37 October through April. Total degree-days under H1 would be 221% to 3,408% higher than those

1 under Existing Conditions during October, November, March, and April, and similar during  
2 December through February (Table 11-4-68).

3 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
4 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H4 would be similar to  
5 results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
6 Overall, results for H4 would be similar to those for H3.

#### 7 *Late Fall-Run*

8 Flows in the Sacramento River upstream of Red Bluff during February through May under H4 would  
9 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
10 *Analysis*). September Shasta storage volume under H4 would generally be similar to September  
11 storage volume under H3 (Table 11-4-27).

12 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
13 February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix  
14 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
15 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
16 between Existing Conditions and H4 during the period.

17 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F  
18 increments was determined for each month during October through April and year of the 82-year  
19 modeling period (Table 11-4-13). The combination of number of days and degrees above the 56°F  
20 threshold were further assigned a “level of concern”, as defined in Table 11-4-14. Differences  
21 between baselines and H1 in the highest level of concern across all months and all 82 modeled years  
22 are presented in Table 11-4-67. There would be 317% and 150% increases in the number of years  
23 with “red” and “orange” levels of concern, respectively, under H1 relative to Existing Conditions.

24 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during  
25 October through April. Total degree-days under H1 would be 221% to 3,408% higher than those  
26 under Existing Conditions during October, November, March, and April, and similar during  
27 December through February (Table 11-4-68).

28 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
29 additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H4 would be similar to  
30 results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
31 Overall, results for H4 would be similar to those for H3.

#### 32 **Clear Creek**

33 No water temperature modeling was conducted in Clear Creek.

#### 34 *Fall-Run*

35 Flows in Clear Creek flows below Whiskeytown Reservoir during October through January would  
36 generally be similar between H4 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish*  
37 *Analysis*). As a result, no additional flow analyses were conducted for H4. Overall, results for H4  
38 would be similar to those for H3.

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River low-flow channel during October through January would be similar  
4 between H4 and H3 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
5 H4 in the high-flow channel would generally be similar to those under H3, except during October, in  
6 which flows would be up to 27% lower depending on water year type. Because flow reductions  
7 would occur in only one month, they are not expected to have a biologically meaningful effect on  
8 fall-run Chinook salmon spawning and egg incubation.

9 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow  
10 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October  
11 through January fall-run Chinook salmon spawning and egg incubation period (*Appendix 11D,*  
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
13 *Fish Analysis*). Mean monthly water temperatures would be under H4 relative to Existing Conditions  
14 by 7% to 9% higher in the low-flow channel and 6% to 8% higher in the high-flow channel  
15 depending on month.

16 Differences in the percent of months exceeding the 56°F NMFS threshold between Existing  
17 Conditions and H4 would be negligible (<5% on an absolute scale) during all months except October,  
18 November, March, and April, in which the percent of months under H4 would be similar to or up to  
19 54% lower (absolute scale) than those under Existing Conditions.

20 Combining all water year types, there would be no difference between Existing Conditions and H4 in  
21 total degree-months exceeded in all months except October, November, March, and April, during  
22 which degree-months under H4 would be greater by up to 309 degree-months (116%).

23 Due to generally similar flows and water temperatures between H4 and H3, results under H4 would  
24 be similar to results for analyses under H3.

25 **American River**

26 *Fall-Run*

27 Flows in the American River at the confluence with the Sacramento River during October through  
28 January would generally be similar between H4 and H3, except during October, in which flows  
29 would be 6% to 13% lower depending on water year type (*Appendix 11C, CALSIM II Model Results*  
30 *utilized in the Fish Analysis*). Because flow reductions would occur in only one month and would be  
31 low in magnitude, they are not expected to have a biologically meaningful effect on fall-run Chinook  
32 salmon spawning and egg incubation.

33 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
34 during the October through January fall-run Chinook salmon spawning and egg incubation period  
35 (*Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
36 *utilized in the Fish Analysis*). Mean monthly temperatures under H4 would be 5% to 12% greater  
37 than those under Existing Conditions depending on month.

38 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
39 Avenue Bridge was evaluated during November through April (Table 11-4-71). The percent of  
40 months exceeding the threshold under H4 would be up to 51% greater (absolute scale) than the

1 percent under Existing Conditions during November, March, and April and similar to the percent  
2 under Existing Conditions during December through February.

3 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
4 Avenue Bridge during November through April (Table 11-4-72). Total degree-months under H4  
5 would be 95% to 395% greater than total degree-months under Existing Conditions during  
6 November, March and April and similar to total degree months under Existing Conditions during  
7 December through February.

8 Due to generally similar flows and water temperatures between H4 and H3, results for additional  
9 analyses (e.g., risk of redd dewatering, Reclamation egg mortality model) under H4 would be similar  
10 to results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
11 Overall, results for H4 would be similar to those for H3.

## 12 ***Stanislaus River***

### 13 *Fall-Run*

14 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
15 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*  
16 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H4 would be 6% to 8% lower  
17 than those under Existing Conditions in all months except January, in which flows would be similar  
18 between Existing Conditions and H4.

19 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were  
20 examined during the October through January fall-run spawning and egg incubation period  
21 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
22 *utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would not be 5% to 6%  
23 higher throughout the period.

## 24 ***San Joaquin River***

### 25 *Fall-Run*

26 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run  
27 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
28 *utilized in the Fish Analysis*). Mean monthly flows under H4 would be similar to those under Existing  
29 Conditions throughout the period, except during January, in which flows would be 6% greater.

30 Water temperature modeling was not conducted in the San Joaquin River.

## 31 ***Mokelumne River***

### 32 *Fall-Run*

33 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run  
34 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*  
35 *utilized in the Fish Analysis*). Flows under H4 would be up to 14% lower than flows under Existing  
36 Conditions during October and November and up to 18% greater than flows under Existing  
37 Conditions during December and January.

38 Water temperature modeling was not conducted in the Mokelumne River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between  
3 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
4 alternative could substantially reduce the amount of suitable habitat of fish, contrary to the NEPA  
5 conclusion set forth above. There would be moderate to substantial flow reductions under  
6 Alternative 4 in the Feather and American Rivers, and substantial increases in temperatures and  
7 temperature exceedances above thresholds in the Sacramento, Feather, and American Rivers, all of  
8 which would affect the fall-run Chinook salmon rearing habitat. Biological models, including the  
9 Reclamation egg mortality model and SacEFT, predict substantially degraded spawning and egg  
10 incubation habitat conditions in the Sacramento, Feather, and American Rivers. These results are  
11 generally consistent among scenarios.

12 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
13 change, future water demands, and implementation of the alternative. The analysis described above  
14 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
15 alternative from those of sea level rise, climate change and future water demands using the model  
16 simulation results presented in this chapter. However, the increment of change attributable to the  
17 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
18 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
19 implementation period, which does include future sea level rise, climate change, and water  
20 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
21 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
22 effect of the alternative from those of sea level rise, climate change, and water demands.

23 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
24 term implementation period and H3 indicates that flows in the locations and during the months  
25 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
26 indicates that the differences between Existing Conditions and Alternative 4 found above would  
27 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
28 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
29 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
30 impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than  
31 significant and no mitigation is required.

32 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**  
33 **(Fall-/Late Fall-Run ESU)**

34 In general, Alternative 4 would not affect the quantity and quality of larval and juvenile rearing  
35 habitat for fall-/late fall-run Chinook salmon relative to the NAA.

36 **H3/ESO**

37 ***Sacramento River***

38 ***Fall-Run***

39 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
40 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

1 *Analysis*). Flows in the Sacramento River upstream of Red Bluff under H3 would be greater than or  
2 similar to flows under NAA throughout the period.

3 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and  
4 juvenile rearing period. As reported in AQUA-58, end of September Shasta Reservoir storage under  
5 H3 would be similar to storage under NAA in all water year types (Table 11-4-27).

6 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
7 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento  
8 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
9 There would be no differences (<5%) in mean monthly water temperature between NAA and H3 in  
10 any month or water year type throughout the period.

11 SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile  
12 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under H3  
13 relative to NAA (Table 11-4-56). SacEFT predicts that there would be a 10% increase in the  
14 percentage of years with “good” (lower) juvenile stranding risk under H3 relative to NAA.

15 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under H3 would be similar  
16 to mortality under NAA.

#### 17 *Late Fall-Run*

18 Sacramento River flows upstream of Red Bluff were examined for the March through July late fall-  
19 run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the  
20 Fish Analysis*). Upstream of Red Bluff, flows under H3 would generally be up to 12% greater than  
21 under NAA during May and June, and similar in the remaining months of the period.

22 Shasta Reservoir storage at the end of September and May would affect flows during the late fall-run  
23 larval and juvenile rearing period. As reported in AQUA-156, end of September Shasta Reservoir  
24 storage under H3 would be similar to storage under NAA in all water year types (Table 11-4-27).

25 As reported in AQUA-40, May Shasta storage volume under H3 would be similar to or greater than  
26 storage under NAA for all water year types (Table 11-4-19).

27 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
28 March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento  
29 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
30 There would be no differences (<5%) in mean monthly water temperature between NAA and H3 in  
31 any month or water year type throughout the period.

32 SacEFT predicts that there would be a 33% decrease in the percentage of years with good juvenile  
33 rearing availability for late fall-run Chinook salmon, measured as weighted usable area, under H3  
34 relative to NAA (Table 11-4-58). SacEFT predicts that there would be a 9% reduction in the  
35 percentage of years with “good” (lower) juvenile stranding risk under H3 relative to NAA, which  
36 would be negligible on an absolute scale (4% difference).

37 SALMOD predicts that late fall-run smolt equivalent habitat-related mortality under H3 would be  
38 similar (<5% difference) to mortality under NAA.

1       **Clear Creek**

2       No water temperature modeling was conducted in Clear Creek.

3       **Fall-Run**

4       Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-  
5       run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6       *Analysis*). Flows under H3 would generally be similar to flows under NAA with few exceptions.

7       **Feather River**

8       **Fall-Run**

9       Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
10       channel) during December through June were reviewed to determine flow-related effects on larval  
11       and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
12       *Analysis*). Relatively constant flows in the low-flow channel throughout this period under H3 would  
13       not differ from those under NAA. In the high-flow channel, flows under H3 would generally be up to  
14       79% greater than flows under NAA during February through June, and would be similar during  
15       December and January.

16       As reported in AQUA-59, May Oroville storage volume under H3 would be similar to storage under  
17       NAA in all water year types (Table 11-4-42).

18       As reported in AQUA-58, September Oroville storage volume under H3 would be similar to volume  
19       in wet, above normal, and below normal water years and 11% to 18% greater than volume under  
20       NAA during dry and critical water years (Table 11-4-39).

21       Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
22       Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
23       Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
24       *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences  
25       (<5%) in mean monthly water temperature between NAA and H3 in any month or water year type  
26       throughout the period at either location.

27       **American River**

28       **Fall-Run**

29       Flows in the American River at the confluence with the Sacramento River were examined for the  
30       January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
31       *Results utilized in the Fish Analysis*). Flows under H3 during January and May would generally be up  
32       to 24% higher than flows under NAA, and similar during January through April.

33       Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
34       during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
35       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
36       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
37       NAA and H3 in any month or water year type throughout the period.

1 **Stanislaus River**

2 *Fall-Run*

3 Flows in the Stanislaus River at the confluence with the San Joaquin River for H3 are not different  
4 from those under NAA, for the January through May fall-run Chinook salmon juvenile rearing period  
5 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA  
7 and H3 throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento*  
8 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

9 **San Joaquin River**

10 *Fall-Run*

11 Flows in the San Joaquin River at Vernalis for H3 are not different from those under NAA, for the  
12 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
13 *Results utilized in the Fish Analysis*)

14 Water temperature modeling was not conducted in the San Joaquin River.

15 **Mokelumne River**

16 *Fall-Run*

17 Flows in the Mokelumne River at the Delta for H3 are not different from those under NAA, for the  
18 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
19 *Results utilized in the Fish Analysis*)

20 Water temperature modeling was not conducted in the Mokelumne River.

21 **H1/LOS**

22 **Sacramento River**

23 *Fall-Run*

24 Sacramento River flows upstream of Red Bluff during January through May under H1 would  
25 generally be similar to or greater than flows under H3 (Appendix 11C, *CALSIM II Model Results*  
26 *utilized in the Fish Analysis*). September Shasta storage volume under H1 would generally be similar  
27 to September storage volume under H3 (Table 11-4-27).

28 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
29 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
30 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
31 There would be no differences (<5%) in mean monthly water temperature between NAA and H1 in  
32 any month or water year type throughout the period.

33 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
34 additional analyses (e.g., SacEFT, SALMOD) under H1 would be similar to results for analyses under  
35 H3. As a result, these additional analyses were not conducted for H1. Overall, results for H1 would  
36 be similar to those for H3.

1 *Late Fall-Run*

2 Sacramento River flows upstream of Red Bluff during March through July under H1 would generally  
3 be similar to or greater than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
4 *Fish Analysis*). May and September Shasta storage volume under H1 would generally be similar to  
5 storage volume under H3 (Table 11-4-19, Table 11-4-27).

6 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
7 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
8 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
9 There would be no differences (<5%) in mean monthly water temperature between NAA and H1 in  
10 any month or water year type throughout the period.

11 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
12 additional analyses (e.g., SacEFT, SALMOD) under H1 would be similar to results for analyses under  
13 H3. As a result, these additional analyses were not conducted for H1. Overall, results for H1 would  
14 be similar to those for H3.

15 **Clear Creek**

16 No water temperature modeling was conducted in Clear Creek.

17 *Fall-Run*

18 Flows in Clear Creek below Whiskeytown Reservoir during January through May under H1 would be  
19 similar to those under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Due  
20 to similar flows between H1 and H3, results for H1 would be similar to those for H3.

21 **Feather River**

22 *Fall-Run*

23 Flows in the Feather River both above (low-flow channel) Thermalito Afterbay during December  
24 through June under H1 would be similar to those under H3 (Appendix 11C, *CALSIM II Model Results*  
25 *utilized in the Fish Analysis*). Flows in the high-flow channel under H1 would generally be similar to  
26 or greater than flows under H3.

27 May and September Oroville storage under H1 would generally be similar to or greater than storage  
28 under H1 (Table 11-4-39, Table 11-4-45).

29 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
30 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
31 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
32 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences  
33 (<5%) in mean monthly water temperature between NAA and H1 in any month or water year type  
34 throughout the period at either location.

35 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for H1  
36 would be similar to those for H3.

1       **American River**

2       *Fall-Run*

3       Flows in the American River at the confluence with the Sacramento River during January through  
4       May under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
5       *utilized in the Fish Analysis*).

6       Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
7       during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
8       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
9       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
10      NAA and H1 in any month or water year type throughout the period.

11      Due to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
12      those for H3.

13      **Stanislaus River**

14      *Fall-Run*

15      Flows in the Stanislaus River at the confluence with the San Joaquin River for H1 are not different  
16      from those under NAA, for the January through May fall-run Chinook salmon juvenile rearing period  
17      (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18      Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA  
19      and H1 throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento*  
20      *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

21      **San Joaquin River**

22      *Fall-Run*

23      Flows in the San Joaquin River at Vernalis for H1 are not different from those under NAA, for the  
24      January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
25      *Results utilized in the Fish Analysis*)

26      Water temperature modeling was not conducted in the San Joaquin River.

27      **Mokelumne River**

28      *Fall-Run*

29      Flows in the Mokelumne River at the Delta for H1 are not different from those under NAA, for the  
30      January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
31      *Results utilized in the Fish Analysis*)

32      Water temperature modeling was not conducted in the Mokelumne River.

33      **H4/HOS**

34      **Sacramento River**

35      Water temperatures in the Sacramento River under H1 would be similar to those under H3.

1 **Fall-Run**

2 Sacramento River flows upstream of Red Bluff during January through May under H4 would  
3 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4 *Analysis*). September Shasta storage volume under H4 would generally be similar to September  
5 storage volume under H3 (Table 11-4-27).

6 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
7 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
8 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
9 There would be no differences (<5%) in mean monthly water temperature between NAA and H4 in  
10 any month or water year type throughout the period.

11 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
12 additional analyses (e.g., SacEFT, SALMOD) under H4 would be similar to results for analyses under  
13 H3. As a result, these additional analyses were not conducted for H4. Overall, results for H4 would  
14 be similar to those for H3.

15 **Late Fall-Run**

16 Sacramento River flows upstream of Red Bluff during March through July under H1 would generally  
17 be similar to or greater than flows under H3, except during June, in which flows would be up to 12%  
18 lower depending on water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
19 *Analysis*). This magnitude of flow reduction is not expected to have a biologically meaningful effect  
20 on fall-run Chinook salmon rearing habitat. May and September Shasta storage volume under H4  
21 would generally be similar to storage volume under H3 (Table 11-4-19, Table 11-4-36).

22 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
23 March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
24 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
25 There would be no differences (<5%) in mean monthly water temperature between NAA and H4 in  
26 any month or water year type throughout the period.

27 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
28 additional analyses (e.g., SacEFT, SALMOD) under H4 would be similar to results for analyses under  
29 H3. As a result, these additional analyses were not conducted for H4. Overall, results for H4 would  
30 be similar to those for H3.

31 **Clear Creek**

32 No water temperature modeling was conducted in Clear Creek.

33 **Fall-Run**

34 Flows in Clear Creek below Whiskeytown Reservoir during January through May under H4 would be  
35 similar to those under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Due  
36 to similar flows between H4 and H3, results for H4 would be similar to those for H3.

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River both above (low-flow channel) Thermalito Afterbay during December  
4 through June under H4 would generally be greater than those under H3 (Appendix 11C, *CALSIM II*  
5 *Model Results utilized in the Fish Analysis*), except during June, in which flows would be up to 39%  
6 lower under H4 than under H3. Because flow reductions would occur in only one month during the  
7 seven month period, they are not expected to have biologically meaningful effects on fall-run  
8 Chinook salmon rearing habitat.

9 May and September Oroville storage under H4 would generally be similar to or greater than storage  
10 under H3 (Table 11-4-39, Table 11-4-45).

11 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
12 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
13 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
14 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences  
15 (<5%) in mean monthly water temperature between NAA and H4 in any month or water year type  
16 throughout the period at either location.

17 Due to similar or increased flows, similar reservoir storage, and similar water temperatures  
18 between H4 and H3, results for H4 would be similar to or better than those for H3.

19 **American River**

20 *Fall-Run*

21 Flows in the American River at the confluence with the Sacramento River during January through  
22 May under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
23 *utilized in the Fish Analysis*).

24 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
25 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
26 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
27 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
28 NAA and H4 in any month or water year type throughout the period.

29 Due to similar flows and water temperatures between H4 and H3, results for H4 would be similar to  
30 those for H3.

31 **Stanislaus River**

32 *Fall-Run*

33 Flows in the Stanislaus River at the confluence with the San Joaquin River for H4 are not different  
34 from those under NAA, for the January through May fall-run Chinook salmon juvenile rearing period  
35 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA  
37 and H4 throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento*  
38 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

1 **San Joaquin River**

2 *Fall-Run*

3 Flows in the San Joaquin River at Vernalis for H4 are not different from those under NAA, for the  
4 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
5 *Results utilized in the Fish Analysis*)

6 Water temperature modeling was not conducted in the San Joaquin River.

7 **Mokelumne River**

8 *Fall-Run*

9 Flows in the Mokelumne River at the Delta for H4 are not different from those under NAA, for the  
10 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
11 *Results utilized in the Fish Analysis*)

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **NEPA Effects:** Taken together, these results indicate that the effect is not adverse because it does not  
14 have the potential to substantially reduce the amount of suitable habitat of fish. Changes in flow  
15 rates and water temperatures are generally small and infrequent under Alternative 4 relative to the  
16 NAA. Therefore, there would be no biologically meaningful effects to fall- or late fall-run Chinook  
17 salmon, except for a moderate reduction in juvenile rearing habitat for late fall-run Chinook salmon  
18 as predicted by SacEFT. Because this effect is isolated, it would not cause the impact to be adverse,  
19 particularly in combination with modeled flow outputs indicating that flows, which drive rearing  
20 habitat availability, would increase during the rearing period. Additionally, SALMOD does not  
21 predict habitat-related effects on late fall-run Chinook salmon in the Sacramento River. Results  
22 would generally not differ among scenarios.

23 **CEQA Conclusion:** In general, Alternative 4 would not affect the quantity and quality of larval and  
24 juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions.

25 **H3/ESO**

26 **Sacramento River**

27 *Fall-Run*

28 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run  
29 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
30 *Analysis*). Flows under H3 would generally be up to 14% greater than flows under Existing  
31 Conditions during May and similar during January through April.

32 As reported in AQUA-58, end of September Shasta Reservoir storage would be 15% to 33% lower  
33 under H3 relative to Existing Conditions, depending on water year type (Table 11-4-27).

34 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
35 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
36 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
37 There would be no differences (<5%) in mean monthly water temperature between Existing  
38 Conditions and H3 in any month or water year type throughout the period.

1 SacEFT predicts that there would be a 15% increase in the percentage of years with good juvenile  
2 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under H3  
3 relative to Existing Conditions (Table 11-4-56). SacEFT predicts that there would be a 29%  
4 reduction in the percentage of years with “good” (lower) juvenile stranding risk under H3 relative to  
5 Existing Conditions.

6 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under H3 would be 9%  
7 lower than mortality under Existing Conditions.

#### 8 *Late Fall-Run*

9 Sacramento River flows upstream of Red Bluff were examined for the March through July late fall-  
10 run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*  
11 *Fish Analysis*). Flows under H3 would generally be up to 20% greater during May and June, and  
12 similar in the remaining months.

13 As reported in AQUA-58, Shasta Existing Conditions storage volume at the end of September under  
14 H3 would be 15% to 33% lower relative to Existing Conditions (Table 11-4-27).

15 As reported in AQUA-40, Shasta Reservoir storage volume at the end of May under H3 would be  
16 similar to volume under Existing Conditions in wet and above normal water years and 8% to 25%  
17 lower than volume under Existing Conditions in below normal, dry, and critical water years (Table  
18 11-4-19).

19 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
20 March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
21 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
22 There would be no differences (<5%) in mean monthly water temperature between Existing  
23 Conditions and H3 in any month or water year type throughout the period.

24 SacEFT predicts that there would be an 7% reduction in the percentage of years with good juvenile  
25 rearing availability for late fall-run Chinook salmon, measured as weighted usable area, under H3  
26 relative to Existing Conditions (Table 11-4-58). SacEFT predicts that there would be a 42%  
27 reduction in the percentage of years with “good” (lower) juvenile stranding risk under H3 relative to  
28 Existing Conditions.

29 SALMOD predicts that late fall-run smolt equivalent habitat-related mortality under H3 would be  
30 7% higher than mortality under Existing Conditions.

#### 31 **Clear Creek**

32 No temperature modeling was conducted in Clear Creek.

#### 33 *Fall-Run*

34 Flows in Clear Creek below Whiskeytown Reservoir were examined from January through May fall-  
35 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
36 *Analysis*). Flows under H3 would generally be up to 29% greater than flows under Existing  
37 Conditions during March and similar to flows under Existing Conditions in the remaining 4 months  
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow  
4 channel) during December through June were reviewed to determine flow-related effects on larval  
5 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Relatively constant flows in the low-flow channel throughout the period under H3 would  
7 not differ from those under Existing Conditions. In the high-flow channel, flows under H3 would  
8 generally be up to 46% during December, up to 142% greater during March through June, and  
9 similar to flows under Existing Conditions during January and February.

10 As reported under AQUA-59, May Oroville storage volume under H3 would be lower than Existing  
11 Conditions by 5% to 20% depending on water year type, except in wet years, in which storage  
12 would be similar to Existing Conditions (Table 11-4-42).

13 As reported in AQUA-58, September Oroville storage volume would be 10% to 35% lower under  
14 A4\_L H3 LT relative to Existing Conditions depending on water year type (Table 11-4-33).

15 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
16 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
17 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
18 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean  
19 monthly water temperatures under H3 would be 5% to 9% lower than those under Existing  
20 Conditions during December through March, but not different from those under Existing Conditions  
21 during April through June. In the high-flow channel, mean monthly water temperatures under H3  
22 would be 6% to 8% lower than those under Existing Conditions during December through February,  
23 but not different from those under Existing Conditions during March through June.

24 **American River**

25 *Fall-Run*

26 Flows in the American River at the confluence with the Sacramento River were examined for the  
27 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*  
28 *Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 31% lower than flows  
29 under Existing Conditions during January and May, up to 27% greater than flows under Existing  
30 Conditions during February and March, and similar to flows under Existing Conditions during April.

31 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
32 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
34 *Fish Analysis*). Mean monthly water temperatures under H3 would be 5% to 7% lower than those  
35 under Existing Conditions in all months during the period.

36 **Stanislaus River**

37 *Fall-Run*

38 Flows in the Stanislaus River at the confluence with the San Joaquin River for H3 would be up to  
39 36% lower than Existing Conditions in January through May fall-run larval and juvenile rearing  
40 period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
2 River were examined during the January through May fall-run Chinook salmon juvenile rearing  
3 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
4 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 5% to  
5 7% lower than those under Existing Conditions in all months during the period.

6 ***San Joaquin River***

7 *Fall-Run*

8 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run  
9 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*  
10 *the Fish Analysis*). Flows under H3 would be similar to flows under Existing Conditions throughout  
11 the period except during January, in which flows would be greater under H3.

12 Water temperature modeling was not conducted in the San Joaquin River.

13 ***Mokelumne River***

14 *Fall-Run*

15 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook  
16 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
17 *Analysis*). Mean monthly flows under H3 would be 14% greater than flows under Existing Conditions  
18 during January, similar to flows under Existing Conditions during February and March, and 8% to  
19 12% lower than flows under Existing Conditions during April and May.

20 Water temperature modeling was not conducted in the Mokelumne River.

21 **H1/LOS**

22 ***Sacramento River***

23 *Fall-Run*

24 Sacramento River flows upstream of Red Bluff during January through May under H1 would  
25 generally be similar to or greater than flows under H3 (Appendix 11C, *CALSIM II Model Results*  
26 *utilized in the Fish Analysis*). September Shasta storage volume under H1 would generally be similar  
27 to September storage volume under H3 (Table 11-4-27, Due to similar flows, reservoir storage, and  
28 water temperatures between H1 and H3, results for additional analyses (e.g., SacEFT, SALMOD)  
29 under H1 would be similar to results for analyses under H3. As a result, these additional analyses  
30 were not conducted for H1. Overall, results for H1 would be similar to those for H3.

31 *Late Fall-Run*

32 Sacramento River flows upstream of Red Bluff during March through July under H1 would generally  
33 be similar to or greater than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
34 *Fish Analysis*).

35 May and September Shasta storage volume under H1 would generally be similar to storage volume  
36 under H3 (Table 11-4-19, Table 11-4-36).

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
2 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
3 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
4 There would be no differences (<5%) in mean monthly water temperature between Existing  
5 Conditions and H1 in any month or water year type throughout the period.

6 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for  
7 additional analyses (e.g., SacEFT, SALMOD) under H1 would be similar to results for analyses under  
8 H3. As a result, these additional analyses were not conducted for H1. Overall, results for H1 would  
9 be similar to those for H3.

### 10 **Clear Creek**

11 No water temperature modeling was conducted in Clear Creek.

#### 12 *Fall-Run*

13 Flows in Clear Creek below Whiskeytown Reservoir during January through May under H1 would be  
14 similar to those under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Due  
15 to similar flows between H1 and H3, results for H1 would be similar to those for H3.

### 16 **Feather River**

#### 17 *Fall-Run*

18 Flows in the Feather River both above (low-flow channel) Thermalito Afterbay during December  
19 through June under H1 would be similar to those under H3 (Appendix 11C, *CALSIM II Model Results*  
20 *utilized in the Fish Analysis*). Flows in the high-flow channel under H1 would generally be similar to  
21 or greater than flows under H3. May and September Oroville storage under H1 would generally be  
22 similar to or greater than storage under H1 (Table 11-4-39, Table 11-4-45).

23 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
24 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
25 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
26 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean  
27 monthly water temperatures under H1 would be 5% to 9% lower than those under Existing  
28 Conditions during December through March, but not different from those under Existing Conditions  
29 during April through June. In the high-flow channel, mean monthly water temperatures under H1  
30 would be 6% to 8% lower than those under Existing Conditions during December through February,  
31 but not different from those under Existing Conditions during March through June.

32 Due to similar flows, reservoir storage, and water temperatures between H1 and H3, results for H1  
33 would be similar to those for H3.

### 34 **American River**

#### 35 *Fall-Run*

36 Flows in the American River at the confluence with the Sacramento River during January through  
37 May under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
38 *utilized in the Fish Analysis*). Due to similar flows and water temperatures between H1 and H3,  
39 results for H1 would be similar to those for H3.

1 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
2 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). Mean monthly water temperatures under H1 would be 5% to 7% lower than those  
5 under Existing Conditions in all months during the period.

6 ***Stanislaus River***

7 *Fall-Run*

8 Flows in the Stanislaus River at the confluence with the San Joaquin River for H1 would be up to  
9 36% lower than Existing Conditions in January through May fall-run larval and juvenile rearing  
10 period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
12 River were examined during the January through May fall-run Chinook salmon juvenile rearing  
13 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
14 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 5% to  
15 7% lower than those under Existing Conditions in all months during the period except April, in  
16 which temperatures would not differ between H1 and Existing Conditions.

17 ***San Joaquin River***

18 *Fall-Run*

19 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run  
20 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*  
21 *the Fish Analysis*). Mean monthly flows under H1 would be similar to flows under Existing  
22 Conditions throughout the period except during January, in which flows would be 5% greater under  
23 H1.

24 Water temperature modeling was not conducted in the San Joaquin River.

25 ***Mokelumne River***

26 *Fall-Run*

27 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook  
28 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
29 *Analysis*). Mean monthly flows under H1 would be 14% and 12% greater than flows under Existing  
30 Conditions during January and February, respectively, similar to flows under Existing Conditions  
31 during March, and 8% and 12% lower than flows under Existing Conditions during April and May,  
32 respectively.

33 Water temperature modeling was not conducted in the Mokelumne River.

1 **H4/HOS**

2 ***Sacramento River***

3 *Fall-Run*

4 Sacramento River flows upstream of Red Bluff during January through May under H4 would  
5 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). September Shasta storage volume under H4 would generally be similar to September  
7 storage volume under H3 (Table 11-4-27). Due to similar flows, reservoir storage, and water  
8 temperatures between H4 and H3, results for additional analyses (e.g., SacEFT, SALMOD) under H4  
9 would be similar to results for analyses under H3. As a result, these additional analyses were not  
10 conducted for H4. Overall, results for H4 would be similar to those for H3.

11 *Late Fall-Run*

12 Sacramento River flows upstream of Red Bluff during March through July under H4 would generally  
13 be similar to or greater than flows under H3, except during June, in which flows would be up to 12%  
14 lower depending on water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
15 *Analysis*). This magnitude of flow reduction is not expected to have a biologically meaningful effect  
16 on fall-run Chinook salmon rearing habitat.

17 May and September Shasta storage volume under H4 would generally be similar to storage volume  
18 under H3 (Table 11-4-19, Table 11-4-36).

19 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
20 March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*  
21 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
22 There would be no differences (<5%) in mean monthly water temperature between Existing  
23 Conditions and H4 in any month or water year type throughout the period.

24 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for  
25 additional analyses (e.g., SacEFT, SALMOD) under H4 would be similar to results for analyses under  
26 H3. As a result, these additional analyses were not conducted for H4. Overall, results for H4 would  
27 be similar to those for H3.

28 ***Clear Creek***

29 No water temperature modeling was conducted in Clear Creek.

30 *Fall-Run*

31 Flows in Clear Creek below Whiskeytown Reservoir during January through May under H4 would be  
32 similar to those under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Due  
33 to similar flows between H4 and H3, results for H4 would be similar to those for H3.

34 ***Feather River***

35 Water temperatures in the Feather River under H4 would be similar to those under H3.

1 **Fall-Run**

2 Flows in the Feather River both above (low-flow channel) Thermalito Afterbay during December  
3 through June under H4 would generally be greater than those under H3 (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*), except during June, in which flows would be up to 39%  
5 lower under H4 than under H3. Because flow reductions would occur in only one month during the  
6 seven month period, they are not expected to have biologically meaningful effects on fall-run  
7 Chinook salmon rearing habitat. May and September Oroville storage under H4 would generally be  
8 similar to or greater than storage under H3 (Table 11-4-39, Table 11-4-45).

9 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
10 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run  
11 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*  
12 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean  
13 monthly water temperatures under H4 would be 5% to 9% lower than those under Existing  
14 Conditions during December through March, but not different from those under Existing Conditions  
15 during April through June. In the high-flow channel, mean monthly water temperatures under H4  
16 would be 6% to 8% lower than those under Existing Conditions during December through February,  
17 but not different from those under Existing Conditions during March through June.

18 Due to similar or increased flows, similar reservoir storage, and similar water temperatures  
19 between H4 and H3, results for H4 would be similar to or better than those for H3.

20 **American River**

21 **Fall-Run**

22 Flows in the American River at the confluence with the Sacramento River during January through  
23 May under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
24 *utilized in the Fish Analysis*). Due to similar flows and water temperatures between H4 and H3,  
25 results for H4 would be similar to those for H3.

26 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined  
27 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,  
28 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
29 *Fish Analysis*). Mean monthly water temperatures under H4 would be 5% to 7% lower than those  
30 under Existing Conditions in all months during the period.

31 **Stanislaus River**

32 **Fall-Run**

33 Flows in the Stanislaus River at the confluence with the San Joaquin River for H4 would be up to  
34 36% lower than Existing Conditions in January through May fall-run larval and juvenile rearing  
35 period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
37 River were examined during the January through May fall-run Chinook salmon juvenile rearing  
38 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
39 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 5% to  
40 7% lower than those under Existing Conditions in all months during the period except April, in  
41 which temperatures would not differ between H4 and Existing Conditions.

1 **San Joaquin River**

2 *Fall-Run*

3 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run  
4 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*  
5 *the Fish Analysis*). Mean monthly flows under H4 would be similar to flows under Existing  
6 Conditions throughout the period except during January, in which flows would be 6% greater under  
7 H4.

8 Water temperature modeling was not conducted in the San Joaquin River.

9 **Mokelumne River**

10 *Fall-Run*

11 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook  
12 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
13 *Analysis*). Mean monthly flows under H4 would be 14% and 12% greater than flows under Existing  
14 Conditions during January and February, respectively, similar to flows under Existing Conditions  
15 during March, and 8% and 12% lower than flows under Existing Conditions during April and May,  
16 respectively.

17 Water temperature modeling was not conducted in the Mokelumne River.

18 **Summary of CEQA Conclusion**

19 Collectively, these results indicate that the impact would not be significant because it does not have  
20 the potential to substantially reduce the amount of suitable habitat of fish, and no mitigation is  
21 necessary. Flows in all rivers examined would not be sufficiently high and frequent to cause  
22 biologically meaningful effects to fall- and late fall-run Chinook salmon.

23 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**  
24 **(Fall-/Late Fall-Run ESU)**

25 In general, the effects of Alternative 4 on fall- and late fall-run Chinook salmon migration conditions  
26 relative to the NAA are uncertain.

27 **Upstream of the Delta**

28 **H3/ESO**

29 **Sacramento River**

30 *Fall-Run*

31 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants  
32 during February through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
33 Flows under H3 would generally be up to 12% greater than flows under NAA during May and  
34 similar to flows under NAA during February through April.

35 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
36 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
2 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
3 NAA and H3 in any month or water year type throughout the period.

4 Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook  
5 salmon upstream migration period (September through October) (Appendix 11C, *CALSIM II Model*  
6 *Results utilized in the Fish Analysis*). Flows under H3 would generally be similar to or greater than  
7 those under NAA except during above normal years during September (6% lower) and below  
8 normal years during September and October (13% and 8% lower, respectively).

9 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
10 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
11 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
12 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
13 between NAA and H3 in any month or water year type throughout the period.

#### 14 *Late Fall-Run*

15 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January  
16 through March) under H3 would generally be similar to flows under NAA (Appendix 11C, *CALSIM II*  
17 *Model Results utilized in the Fish Analysis*).

18 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
19 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
20 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
21 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
22 NAA and H3 in any month or water year type throughout the period.

23 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon  
24 upstream migration period (December through February) under H3 would be generally be similar  
25 to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
27 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,  
28 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
29 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
30 NAA and H3 in any month or water year type throughout the period.

#### 31 **Clear Creek**

32 Water temperature modeling was not conducted in Clear Creek.

#### 33 *Fall-Run*

34 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run  
35 migrants during February through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
36 *Analysis*). Flows under H3 would generally be similar to those under NAA with few exceptions.

37 Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run  
38 Chinook salmon upstream migration period (September through October) (Appendix 11C, *CALSIM II*  
39 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be similar to flows under  
40 NAA with few exceptions.

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River at the confluence with the Sacramento River were reviewed for the fall-  
4 run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results*  
5 *utilized in the Fish Analysis*). Flows under H3 would generally be up to 23% greater than flows under  
6 NAA during April and May and similar to flows under NAA during February and March.

7 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
8 were examined during the February through May juvenile fall-run Chinook salmon migration period  
9 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
10 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
11 temperature between NAA and H3 in any month or water year type throughout the period.

12 Flows in the Feather River at the confluence with the Sacramento River were reviewed for the  
13 September through October fall-run Chinook salmon adult migration period (Appendix 11C, *CALSIM*  
14 *II Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 27% lower  
15 than flows under NAA in September but up to 22% greater than flows under NAA in October.

16 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17 were examined during the September through October fall-run Chinook salmon adult upstream  
18 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
19 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
20 mean monthly water temperature between NAA and H3 in any month or water year type  
21 throughout the period.

22 **American River**

23 *Fall-Run*

24 Flows in the American River at the confluence with the Sacramento River were examined during the  
25 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 24% greater  
27 than flows under NAA during May, and similar to flows under NAA during February through April.

28 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
29 River were examined during the February through May juvenile fall-run Chinook salmon migration  
30 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
31 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
32 temperature between NAA and H3 in any month or water year type throughout the period.

33 Flows in the American River at the confluence with the Sacramento River were examined during the  
34 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*). Flows H3 would generally be up to 17% lower  
36 during September and similar to flows under NAA during October.

37 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
38 River were examined during the September and October adult fall-run Chinook salmon upstream  
39 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
40 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in

1 mean monthly water temperature between NAA and H3 in any month or water year type  
2 throughout the period.

3 **Stanislaus River**

4 *Fall-Run*

5 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
6 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
7 *Model Results utilized in the Fish Analysis*). Flows under H3 would be similar to those under NAA in  
8 all months and water year types throughout the period.

9 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
10 River were examined during the September and October adult fall-run Chinook salmon upstream  
11 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
12 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
13 mean monthly water temperature between NAA and H3 in any month or water year type  
14 throughout the period.

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
16 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
17 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would be similar to those  
18 under NAA in all months and water year types throughout the period.

19 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
20 River were examined during the September and October adult fall-run Chinook salmon upstream  
21 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
22 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
23 mean monthly water temperature between NAA and H3 in any month or water year type  
24 throughout the period.

25 **San Joaquin River**

26 *Fall-Run*

27 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
28 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
29 *Analysis*). Flows under H3 would be similar to those under NAA in all months and water year types  
30 throughout the period.

31 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
32 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
33 *in the Fish Analysis*). Flows under H3 would be similar to those under NAA in all months and water  
34 year types throughout the period.

35 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 *Fall-Run*

3 Flows in the Mokelumne River at the Delta were examined during the February through May  
4 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
5 *the Fish Analysis*). Flows under H3 would be similar to those under NAA in all months and water  
6 year types throughout the period.

7 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
8 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
9 *in the Fish Analysis*). Flows under H3 would be similar to those under NAA in all months and water  
10 year types throughout the period.

11 Water temperature modeling was not conducted in the Mokelumne River.

12 **H1/LOS**

13 **Sacramento River**

14 *Fall-Run*

15 Flows in the Sacramento River upstream of Red Bluff were examined for the juvenile fall-run  
16 Chinook salmon downstream migration period (February through May) (Appendix 11C, *CALSIM II*  
17 *Model Results utilized in the Fish Analysis*). Flows under H1 would generally be similar to flows under  
18 NAA throughout the period.

19 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
20 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
21 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
22 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
23 NAA and H1 in any month or water year type throughout the period.

24 Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook  
25 salmon upstream migration period (September through October) (Appendix 11C, *CALSIM II Model*  
26 *Results utilized in the Fish Analysis*). Mean monthly flows under H1 would be 25% lower during  
27 September relative to those under NAA, but there would be no difference in flows between NAA and  
28 H1 during October.

29 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
30 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
31 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
32 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
33 between NAA and H1 in any month or water year type throughout the period.

34 *Late Fall-Run*

35 Flows in the Sacramento River upstream of Red Bluff were examined for the juvenile fall-run  
36 Chinook salmon downstream migration period (January through March) (Appendix 11C, *CALSIM II*  
37 *Model Results utilized in the Fish Analysis*). Flows under H1 would generally be similar to flows under  
38 H3 throughout the period.

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
2 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 NAA and H1 in any month or water year type throughout the period.

6 Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook  
7 salmon upstream migration period (December through February) (Appendix 11C, CALSIM II Model  
8 Results utilized in the Fish Analysis). Flows under H1 would generally be similar to flows under H3  
9 throughout the period.

10 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
11 December through February adult late fall-run Chinook salmon upstream migration period  
12 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
13 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
14 temperature between NAA and H1 in any month or water year type throughout the period.

### 15 **Clear Creek**

16 Water temperature modeling was not conducted in Clear Creek.

#### 17 *Fall-Run*

18 Flows in the Clear Creek below Whiskeytown Reservoir during February through May under H1  
19 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
20 *Fish Analysis*). Flows in the Clear Creek below Whiskeytown Reservoir during September through  
21 October under H1 would generally be similar to flows under H3. Due to similar flows between H1  
22 and H3, results for H1 would be similar to those for H3.

### 23 **Feather River**

#### 24 *Fall-Run*

25 Flows in the Feather River at the confluence with the Sacramento River during the February through  
26 May juvenile late fall-run Chinook salmon emigration period under H1 would be similar to flows  
27 under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
29 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
30 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
31 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
32 NAA and H1 in any month or water year type throughout the period.

33 Flows in the Feather River at the confluence with the Sacramento River during September through  
34 October under H1 would be similar to flows under H3 except in wet and above normal water years  
35 during September during which flows would be 65% and 40% lower than flows under H3,  
36 respectively. Although large reductions, they occur in the wettest water year types and, therefore,  
37 are not expected to have biologically meaningful effects on fall-run Chinook salmon.

38 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
39 were examined during the September through October fall-run Chinook salmon adult upstream  
40 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*

1 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
2 mean monthly water temperature between NAA and H1 in any month throughout the period. There  
3 would be a 6% reduction in water temperatures under H1 in wet years during September.

#### 4 **American River**

##### 5 *Fall-Run*

6 Flows in the American River at the confluence with the Sacramento River during February through  
7 May under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
8 *utilized in the Fish Analysis*).

9 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
10 River were examined during the February through May juvenile fall-run Chinook salmon migration  
11 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
12 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
13 temperature between NAA and H1 in any month or water year type throughout the period.

14 Flows in the American River at the confluence with the Sacramento River during September through  
15 October under H1 would generally be similar to flows under H3 except in wet and above normal  
16 water years during September during which flows would be 38% and 19% lower than flows under  
17 H3, respectively. Although small to moderate reductions, they occur in the wettest water year types  
18 and, therefore, are not expected to have biologically meaningful effects on fall-run Chinook salmon.

19 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
20 River were examined during the September and October adult fall-run Chinook salmon upstream  
21 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
22 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
23 mean monthly water temperature between NAA and H1 in any month or water year type  
24 throughout the period.

#### 25 **Stanislaus River**

##### 26 *Fall-Run*

27 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
28 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
29 *Model Results utilized in the Fish Analysis*). Flows under H1 would be similar to those under NAA in  
30 all months and water year types throughout the period.

31 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
32 River were examined during the September and October adult fall-run Chinook salmon upstream  
33 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
34 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
35 mean monthly water temperature between NAA and H1 in any month or water year type  
36 throughout the period.

37 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
38 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
39 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would be similar to those  
40 under NAA in all months and water year types throughout the period.

1 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
2 River were examined during the September and October adult fall-run Chinook salmon upstream  
3 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
4 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
5 mean monthly water temperature between NAA and H1 in any month or water year type  
6 throughout the period.

#### 7 ***San Joaquin River***

##### 8 *Fall-Run*

9 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
10 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
11 *Analysis*). Flows under H1 would be similar to those under NAA in all months and water year types  
12 throughout the period.

13 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
14 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
15 *in the Fish Analysis*). Flows under H1 would be similar to those under NAA in all months and water  
16 year types throughout the period.

17 Water temperature modeling was not conducted in the San Joaquin River.

#### 18 ***Mokelumne River***

##### 19 *Fall-Run*

20 Flows in the Mokelumne River at the Delta were examined during the February through May  
21 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
22 *the Fish Analysis*). Flows under H1 would be similar to those under NAA in all months and water  
23 year types throughout the period.

24 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
25 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
26 *in the Fish Analysis*). Flows under H1 would be similar to those under NAA in all months and water  
27 year types throughout the period.

28 Water temperature modeling was not conducted in the Mokelumne River.

#### 29 **H4/HOS**

##### 30 ***Sacramento River***

##### 31 *Fall-Run*

32 Flows in the Sacramento River upstream of Red Bluff were examined for the juvenile fall-run  
33 Chinook salmon downstream migration period (February through May) (Appendix 11C, *CALSIM II*  
34 *Model Results utilized in the Fish Analysis*). Flows under H4 would generally be similar to flows under  
35 NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
37 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
38 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
2 NAA and H4 in any month or water year type throughout the period.

3 Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook  
4 salmon upstream migration period (September through October) (Appendix 11C, *CALSIM II Model*  
5 *Results utilized in the Fish Analysis*). Mean monthly flows under H4 would be 6% higher during  
6 September relative to those under NAA, but there would be no difference in flows between NAA and  
7 H4 during October.

8 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
9 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
10 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
11 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
12 between NAA and H4 in any month or water year type throughout the period.

### 13 *Late Fall-Run*

14 Flows in the Sacramento River upstream of Red Bluff were examined for the juvenile fall-run  
15 Chinook salmon downstream migration period (January through March) (Appendix 11C, *CALSIM II*  
16 *Model Results utilized in the Fish Analysis*). Flows under H4 would generally be similar to flows under  
17 NAA throughout the period.

18 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
19 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
20 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
21 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
22 NAA and H4 in any month or water year type throughout the period.

23 Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook  
24 salmon upstream migration period (December through February) (Appendix 11C, *CALSIM II Model*  
25 *Results utilized in the Fish Analysis*). Flows under H4 would generally be similar to flows under NAA  
26 throughout the period.

27 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
28 December through February adult late fall-run Chinook salmon upstream migration period  
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
30 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
31 temperature between NAA and H4 in any month or water year type throughout the period.

### 32 **Clear Creek**

33 Water temperature modeling was not conducted in Clear Creek.

### 34 *Fall-Run*

35 Flows in the Clear Creek below Whiskeytown Reservoir during February through May under H4  
36 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
37 *Fish Analysis*). Flows in the Clear Creek below Whiskeytown Reservoir during September through  
38 October under H4 would generally be similar to flows under H3. Due to similar flows between H4  
39 and H3, results for H4 would be similar to those for H3.

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River at the confluence with the Sacramento River during the February through  
4 May juvenile late fall-run Chinook salmon emigration period under H4 would be similar to or  
5 greater than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
7 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
8 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
9 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
10 NAA and H4 in any month or water year type throughout the period.

11 Flows in the Feather River at the confluence with the Sacramento River during September through  
12 October under H4 would be higher than, similar to, or lower than flows under H1 depending on  
13 month and water year type. On average, flows would be 5% and 6% lower under H4 relative to H3  
14 in September, and October, respectively. These reductions would not be of high enough magnitude  
15 to have a biologically meaningful effect on fall-run Chinook salmon adult migration.

16 **American River**

17 Water temperatures in the American River under H4 would be the same as those under H3.

18 *Fall-Run*

19 Flows in the American River at the confluence with the Sacramento River during February through  
20 May under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
21 *utilized in the Fish Analysis*).

22 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
23 River were examined during the February through May juvenile fall-run Chinook salmon migration  
24 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
25 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
26 temperature between NAA and H4 in any month or water year type throughout the period.

27 Flows in the American River at the confluence with the Sacramento River under H4 would generally  
28 be greater than flows under H3 during September and generally lower than flows under H3 during  
29 October depending on water year type. On average, flows under H4 would be 16% higher during  
30 September and 8% lower during October. The September increase would have a small to moderate  
31 biologically meaningful effect on fall-run Chinook salmon adult migration although October decrease  
32 would be too small to have a biologically meaningful effect.

33 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
34 River were examined during the September and October adult fall-run Chinook salmon upstream  
35 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
36 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
37 mean monthly water temperature between NAA and H4 in any month or water year type  
38 throughout the period.

1       **Stanislaus River**

2       *Fall-Run*

3       Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
4       February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
5       *Model Results utilized in the Fish Analysis*). Flows under H4 would be similar to those under NAA in  
6       all months and water year types throughout the period.

7       Mean monthly water temperatures in the American River at the confluence with the Sacramento  
8       River were examined during the September and October adult fall-run Chinook salmon upstream  
9       migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
10       *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
11       mean monthly water temperature between NAA and H4 in any month or water year type  
12       throughout the period.

13       Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
14       September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
15       *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would be similar to those  
16       under NAA in all months and water year types throughout the period.

17       Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
18       River were examined during the September and October adult fall-run Chinook salmon upstream  
19       migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
20       *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
21       mean monthly water temperature between NAA and H4 in any month or water year type  
22       throughout the period.

23       **San Joaquin River**

24       *Fall-Run*

25       Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
26       Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
27       *Analysis*). Flows under H4 would be similar to those under NAA in all months and water year types  
28       throughout the period.

29       Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
30       fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
31       *in the Fish Analysis*). Flows under H4 would be similar to those under NAA in all months and water  
32       year types throughout the period.

33       Water temperature modeling was not conducted in the San Joaquin River.

34       **Mokelumne River**

35       *Fall-Run*

36       Flows in the Mokelumne River at the Delta were examined during the February through May  
37       juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
38       *the Fish Analysis*). Flows under H4 would be similar to those under NAA in all months and water  
39       year types throughout the period.

1 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
2 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
3 *in the Fish Analysis*). Flows under H4 would be similar to those under NAA in all months and water  
4 year types throughout the period.

5 Water temperature modeling was not conducted in the Mokelumne River.

6 **Through-Delta**

7 ***Sacramento River***

8 *Fall-Run*

9 *Juveniles*

10 Alternative 4 operations would generally reduce OMR reverse flows under Scenarios H3 and H1  
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), with a corresponding increase  
12 in net positive downstream flows, during the migration period of Chinook salmon through the  
13 interior Delta channels. Conditions under Scenario H4 would further improve overall average OMR  
14 flows compared to NAA. These improved net positive downstream flows would be substantial  
15 benefits of the proposed operations.

16 Predation risk at the north Delta would be increased due to the installation of the proposed  
17 SWP/CVP North Delta intake facilities on the Sacramento River. Bioenergetics modeling with a  
18 median predator density predicts a predation loss under Alternative 4 of less than 0.6% of the  
19 annual juvenile production (0.25% fall run; 0.58% late fall-run) (Table 11-4-73). A conservative  
20 assumption of 5% loss per intake would yield a cumulative loss of about 13% of juvenile fall-run and  
21 late fall-run Chinook that reach the north Delta. This assumption is uncertain and represents an  
22 upper bound estimate. For a discussion of this topic see Impact AQUA-42 for Alternative 1A.

23 **Table 11-4-73. Fall-Run and Late Fall-Run Chinook Salmon Juvenile Predation Loss at the proposed**  
24 **North Delta Diversion intakes for Alternative 4 (Three Intakes)**

Density	Striped Bass at NDD (Three Intakes)		Fall-Run Chinook		Late Fall-Run Chinook	
	Bass per 1,000 Feet of Intake	Total Number of Bass	Number Consumed (LLT)	Percentage of Annual Production	Number Consumed (LLT)	Percentage of Annual Production
Low	18	86	23,395	0.04%	3,795	0.09%
Median	119	571	154,665	0.25%	25,089	0.58%
High	219	1,051	284,636	0.46%	46,172	1.07%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

25

1       **H3/ESO and H1/LOS**

2       Flows below the north Delta intakes would be reduced during the juvenile emigration period for  
3       fall-run Chinook (February through May) and late fall-run Chinook salmon (January through March),  
4       which may increase predation potential. Mean monthly flows would decrease about 14% to 21%  
5       under H3, and decrease 15% to 27% under H1, with reductions up to 28% in April of above normal  
6       years compared to NAA.

7       Under Scenario H3, Through-Delta survival of Sacramento River fall-run Chinook salmon, as  
8       estimated by the Delta Passage Model, averaged 24.4% across all years, 21.7% in drier years and  
9       29% in wetter years (Table 11-4-74). Compared to NAA, average survival under Scenario H3 would  
10      be similar across all years. Juvenile survival under Scenario H1 (low outflow) was similar to  
11      Scenario H3.

12      **H4/HOS**

13      Under the high outflow scenario H4, mean monthly flows would decrease by about 5% to 23%  
14      during the emigration period, with the greatest relative reduction of 28% in November of below  
15      normal years. Under H4, flow decreases in April and May would be less than 10% compared to NAA.  
16      Survival under Scenario H4 would be slightly greater than NAA (3% relative difference).

17      Overall, Alternative 4 would not have an adverse effect on Sacramento River fall-run Chinook  
18      salmon juvenile survival due to minor differences in survival for most operations, and slight  
19      increase in survival for the high outflow operations Scenario H4.

1 **Table 11-4-74. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**  
 2 **Alternative 4 (Scenarios H3, H1 and H4)**

Water Year Type	Average Percentage Survival					Difference in Percentage Survival (Relative Difference)					
	Scenario					EXISTING CONDITIONS vs. Alt 4 Scenario			NAA vs. Alt 4 Scenario		
	EXISTING CONDITIONS	NAA	H3	H1	H4	H3	H1	H4	H3	H1	H4
<b>Sacramento</b>											
Wetter	34.5	31.1	29.0	29.0	32.2	-5.5 (-15%)	-5.5 (-16%)	-2.3 (-7%)	-2.1 (-6%)	-2.1 (-7%)	1.1 (3%)
Drier	20.6	20.8	21.7	21.6	21.4	1.1 (7%)	1.0 (5%)	0.8 (4%)	0.9 (4%)	0.8 (4%)	0.6 (3%)
All Years	25.8	24.7	24.4	24.4	25.5	-1.4 (-1%)	-1.4 (-6%)	-0.3 (-1%)	-0.2 (-1%)	-0.3 (-1%)	0.8 (3%)
<b>Mokelumne</b>											
Wetter	17.2	15.7	17.2	17.2	18.0	<0.1 (<1%)	0.0 (0%)	0.8 (5%)	1.5 (9%)	1.5 (10%)	2.3 (15%)
Drier	15.6	15.9	15.8	15.8	16.1	0.2 (1%)	0.2 (1%)	0.5 (3%)	-0.1 (-1%)	-0.1 (-1%)	0.2 (1%)
All Years	16.2	15.9	16.3	16.4	16.8	0.1 (1%)	0.2 (1%)	0.6 (4%)	0.5 (3%)	0.5 (3%)	0.9 (6%)
<b>San Joaquin</b>											
Wetter	19.3	20.3	17.0	17.0	16.7	-2.4 (-12%)	-2.3 (-12%)	-2.6 (-13%)	-3.3 (-16%)	-3.3 (-16%)	-3.6 (-18%)
Drier	10.0	9.5	11.0	11.0	10.7	1.0 (10%)	1.0 (10%)	0.7 (7%)	1.4 (14%)	1.5 (16%)	1.2 (13%)
All Years	13.5	13.6	13.2	13.2	12.9	-0.3 (-2%)	-0.3 (-2%)	-0.6 (-4%)	-0.3 (-3%)	-0.4 (-3%)	-0.7 (-5%)

Note: Average Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal Water Years (6 years).

Drier = Below Normal, Dry and Critical Water Years (10 years).

H3 = ESO operations, H1 = Low Outflow, H4 = High Outflow.

3

4 **Adults**

5 Attraction flows and olfactory cues in the west Delta for migrating adults would be altered because  
 6 of shifts in exports from the south Delta to the North Delta under Alternative 4. Sacramento River  
 7 flows downstream of the north Delta diversion would be reduced, with concomitant increase in San  
 8 Joaquin River flow contribution.

9 Results of fingerprint simulation modeling (DSM2 modeling of percentage of water at Collinsville  
 10 that originated in the Sacramento River water) for Scenario H3 predicted a minimal reduction in  
 11 Sacramento River source water September–November (1–3% less) compared with NAA (Table 11-  
 12 4-75). The effect would be even lower under Scenario H4 because exports from the north Delta  
 13 would be lower than under Scenario H3 and H1. Studies indicate that a 10% or less reduction in  
 14 source flows that provides olfactory cues would not adversely affect adult attraction (Fretwell  
 15 1989). The reduction in olfactory cues under Scenario H3 is small and is expected to be within the

1 broad range of olfactory cues and migration conditions that currently occur within the lower reach  
2 of the Sacramento River.

3 **Table 11-4-75. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San**  
4 **Joaquin River during the Adult Fall-Run and Late Fall-Run Chinook Salmon Migration Period for**  
5 **Alternative 4 (Scenario H3)**

Month	Scenario			Percentage Difference	
	EXISTING CONDITIONS	NAA	A4 (H3)	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
<b>Fall-Run—Sacramento River</b>					
September	60	65	63	3	-2
October	60	68	67	7	-1
November	60	66	63	3	-3
December	67	66	66	-1	0
<b>Fall-Run—San Joaquin River</b>					
September	0.3	0.1	1.2	0.9	1.1
October	0.2	0.3	3.3	3.1	3
November	0.4	1.0	4.9	4.5	3.9
December	0.9	1.0	2.9	2	1.9
<b>Late Fall-Run—Sacramento River</b>					
December	67	66	66	-1	0
January	76	75	73	-3	-2
February	75	72	68	-7	-4
March	78	76	68	-10	-8
Shading indicates 10% or greater absolute difference.					

6

7 *Late Fall-Run*

8 *Juveniles*

9 Alternative 4 operations would generally reduce OMR reverse flows under all flow scenarios  
10 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), with a corresponding increase  
11 in net positive downstream flows that would benefit juveniles migrating through the Delta. Reduced  
12 flows below the north Delta intakes may increase predation potential. Through-Delta survival by  
13 emigrating juvenile late fall-run Chinook salmon under Scenario H3 averaged 23% across all years,  
14 20.5% in drier years, and 27.3% in wetter years (Table 11-4-76). Juvenile survival under the  
15 Scenario H3 was similar or slightly greater than under NAA for drier, wetter and all years averaged  
16 (around 1% more in relative difference) (Table 11-4-76). Overall, Alternative 4 would not have an  
17 adverse effect on late fall-run Chinook salmon juvenile survival due to similar survival between  
18 Alternative 4 and NAA during all water year types.

1 **Table 11-4-76. Through-Delta Survival (%) of Emigrating Juvenile Late Fall-Run Chinook Salmon under**  
 2 **Alternative 4 (Scenarios H3, H1, and H4)**

Water Year Type	Average Percentage Survival					Difference in Percentage Survival (Relative Difference)					
	Scenario					EXISTING CONDITIONS vs. Alt 4 Scenario			NAA vs. Alt 4 Scenario		
	EXISTING CONDITIONS	NAA	H3	H1	H4	H3	H1	H4	H3	H1	H4
Wetter	28.8	27.3	27.3	26.9	27.2	-1.4 (-5%)	-1.9 (-7%)	-1.6 (-5%)	0.0 (0%)	-0.4 (-2%)	-0.1 (0%)
Drier	18.8	20.2	20.5	19.7	20.2	1.7 (9%)	0.9 (5%)	1.4 (7%)	0.3 (1%)	-0.5 (-2%)	0.0 (0%)
All Years	22.5	22.9	23.0	22.4	22.8	0.5 (2%)	-0.1 (0%)	0.3 (1%)	0.2 (1%)	-0.5 (-2%)	-0.1 (0%)

Note: Delta Passage Model results for survival to Chipps Island.  
 Wetter = Wet and Above Normal Water Years (6 years).  
 Drier = Below Normal, Dry and Critical Water Years (10 years)

3

4 *Adults*

5 Flows in the Sacramento River downstream of the north Delta intake diversions would be reduced  
 6 under Alternative 4, with concomitant proportional increases in San Joaquin River flows. Under  
 7 Scenario H3, the percentage of Sacramento River water at Collinsville would be unchanged in  
 8 December, and slightly reduced (2% to 8%) in January through March compared to NAA (Table 11-  
 9 4-75). This effect would be less under Scenario H4 compared to Scenarios H3 and H1 because it  
 10 would involve fewer exports from the north Delta. The effect on olfactory cues for migrating adults  
 11 late fall-run Chinook salmon would be negligible because the change in flow proportions is less than  
 12 10%.

13 *Mokelumne River*

14 *Fall-Run*

15 *Juveniles*

16 Through-Delta survival of Mokelumne River fall-run Chinook salmon under Scenario H3 averaged  
 17 16% across all years and water year types (Table 11-4-58). Survival under Scenario H3 was similar  
 18 to NAA averaged across all years (0.5% greater, or 3% more in relative difference) and in drier years  
 19 (a 1% relative difference), and 1.5% increase in survival (an 9% relative difference) in wetter years.  
 20 Juvenile survival under Scenario H1 (low outflow) and H4 (high outflow) was similar to Scenario H3  
 21 and NAA in drier years, slightly increased averaged across all years. In wetter years, survival  
 22 increased 1.5% (10% relative difference) under Scenario H1 and 2.3% under Scenario H4 (a 15%  
 23 relative difference). Overall, Alternative 4 would not have an adverse effect on fall-run Chinook  
 24 salmon juvenile survival due to minor differences in survival for most operations, and slight  
 25 increase in survival for the high outflow years or operations Scenario H4.

1 **San Joaquin River**2 *Fall-Run*3 *Juveniles*

4 Under Alternative 4 Scenario H3 operations, through-Delta survival by juvenile fall-run Chinook  
5 salmon emigrating from the San Joaquin River averaged 13% across all years, 11% in drier years,  
6 and 17% in wetter years (Table 11-4-74). Compared to NAA, average survival was similar for all  
7 years averaged for all operations scenarios (H3, H1, and H4). Survival is slightly increased in drier  
8 years (1% greater, a 13-16% relative difference). Survival is greatest in wetter years, but is slightly  
9 reduced relative to NAA by about 3% (16–18% relative difference for Scenarios H1, H3, and H4).  
10 Overall, Alternative 4 would not have an adverse effect on through-Delta migration due to minor  
11 differences in survival.

12 *Adults*

13 The percentage of water at Collinsville that originated from the San Joaquin River is very small (no  
14 more than 1% under NAA) during the fall-run migration period (September to December). The  
15 fingerprinting analysis showed a small increase in olfactory cues from the San Joaquin River passing  
16 downstream through the Delta under Scenario H3 (Table 11-4-75). Although the relative change is  
17 substantial (i.e., close to double the percentage of flow in the San Joaquin under Scenario H3 than  
18 under NAA), the percentage of flow attributable to San Joaquin River water under all scenarios is  
19 quite low (no more than 5%). Scenario H4 would not have as great a relative change because  
20 exports at the north Delta diversion would be lower than under Scenarios H3 and H1. Overall,  
21 Alternative 4 operations conditions would incremental increase olfactory cues associated with  
22 attraction flows in the lower San Joaquin River, but the increase would be small. This would not be  
23 an adverse effect on adult fall-run Chinook salmon migrating to the San Joaquin River.

24 **NEPA Effects:** Upstream of the Delta, these results indicate that the effect would not be adverse  
25 because it does not have the potential to substantially interfere with the movement of fish. Although  
26 some flow reductions are predicted, these flows would not be of sufficient magnitude to cause  
27 biologically meaningful effect on fall- and late fall-run Chinook salmon migration.

28 Near-field effects of Alternative 4 NDD on fall- and late fall-run Chinook salmon related to  
29 impingement and predation associated with three new intake structures could result in negative  
30 effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high  
31 uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be  
32 directly correlated to the number of new intake structures in the river and thus the level of impacts  
33 associated with 3 new intakes would be considerably lower than those expected from having 5 new  
34 intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1%  
35 mortality) to more significant effects (~ 13% mortality above current baseline levels). CM15 would  
36 be implemented with the intent of providing localized and temporary reductions in predation  
37 pressure at the NDD. Additionally, several pre-construction surveys to better understand how to  
38 minimize losses associated with the three new intake structures will be implemented as part of the  
39 final NDD screen design effort. Alternative 4 also includes an Adaptive Management Program and  
40 Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended  
41 to provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time,  
42 due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the  
43 degree of mortality expected from near-field effects at the NDD remains highly uncertain.

1 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
2 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
3 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 4  
4 predict improvements in smolt condition and survival associated with increased access to the Yolo  
5 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
6 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
7 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

8 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
9 all of these elements of BDCP operations and conservation measures to predict smolt migration  
10 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
11 migration survival under Alternative 4 would be similar to those estimated for NAA. Further  
12 refinement and testing of the DPM, along with several ongoing and planned studies related to  
13 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
14 future. These efforts are expected to improve our understanding of the relationships and  
15 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
16 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.  
17 However, until these efforts are completed and their results are fully analyzed, the overall  
18 cumulative effect of Alternative 4 on fall- and late fall-run Chinook salmon migration remains  
19 uncertain. Similarly, the impact on the fall-run Chinook salmon commercial fishery would be  
20 uncertain.

21 **CEQA Conclusion:** In general, Alternative 4 would not affect the migration conditions for fall-/late  
22 fall-run Chinook salmon relative to Existing Conditions.

## 23 **Upstream of the Delta**

### 24 **H3/ESO**

#### 25 ***Sacramento River***

##### 26 *Fall-Run*

27 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants  
28 during February through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
29 Flows under H3 would generally be up to 14% greater than those under Existing Conditions during  
30 May, and similar to flows under Existing Conditions during February through April.

31 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
32 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,  
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
34 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
35 Existing Conditions and H3 in any month throughout the period. There would be a 5% increase in  
36 water temperatures in wet water years during May.

37 Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run  
38 Chinook salmon upstream migration period (September through October) (Appendix 11C, *CALSIM II*  
39 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be similar to or those  
40 under Existing Conditions with some exceptions.

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
2 September through October adult fall-run Chinook salmon upstream migration period (Appendix  
3 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
4 *the Fish Analysis*). Mean monthly water temperatures under H3 would be 5% and 6% greater than  
5 those under H3 during September and October, respectively.

6 *Late Fall-Run*

7 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January  
8 through March) under H3 would generally be similar to flows under Existing Conditions, with few  
9 exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
11 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,  
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
13 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
14 Existing Conditions and H3 in any month or water year type, except in critical years during January  
15 (5% higher).

16 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon  
17 upstream migration period (December through February) under H3 would generally be similar to  
18 flows under Existing Conditions, with few exceptions (Appendix 11C, *CALSIM II Model Results*  
19 *utilized in the Fish Analysis*).

20 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the  
21 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,  
22 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
23 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
24 Existing Conditions and H3 in any month throughout the period, except in critical years during  
25 January (5% higher).

26 **Clear Creek**

27 *Fall-Run*

28 Flows in Clear Creek below Whiskeytown Reservoir were examined during the juvenile fall-run  
29 Chinook salmon upstream migration period (February through May). Flows under H3 would  
30 generally be greater than those under Existing Conditions during March and similar to flows under  
31 Existing Conditions during February, April, and May (Appendix 11C, *CALSIM II Model Results utilized*  
32 *in the Fish Analysis*).

33 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon  
34 upstream migration period (September through October) under H3 would generally be similar to  
35 those under Existing Conditions with few exceptions (Appendix 11C, *CALSIM II Model Results utilized*  
36 *in the Fish Analysis*).

37 Water temperature modeling was not conducted in Clear Creek

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile  
4 migration period (February through May) under H3 would generally be similar to flows under  
5 Existing Conditions, with few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*).

7 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
8 were examined during the February through May juvenile fall-run Chinook salmon migration period  
9 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
10 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
11 temperature between Existing Conditions and H3 in any month throughout the period.

12 Flows in the Feather River at the confluence with the Sacramento River were examined during the  
13 September through October fall-run Chinook salmon adult migration period. Flows under H3 would  
14 generally be up to 108% greater than flows under Existing Conditions during both months  
15 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17 were examined during the September through October fall-run Chinook salmon adult upstream  
18 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
19 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in  
20 mean monthly water temperature between Existing Conditions and H3 in any month throughout the  
21 period.

22 **American River**

23 *Fall-Run*

24 Flows in the American River at the confluence with the Sacramento River were examined during the  
25 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*  
26 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 27% greater  
27 than flows under Existing Conditions during February and March, up to 31% lower during May, and  
28 similar to flows under Existing Conditions during April.

29 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
30 River were examined during the February through May juvenile fall-run Chinook salmon migration  
31 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
32 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 5% to  
33 7% higher than under Existing Conditions in all month except April, in which there would be no  
34 difference.

35 Flows in the American River at the confluence with the Sacramento River were examined during the  
36 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
37 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would be 27% to 51% lower  
38 than flows under Existing Conditions during September and similar to flows under Existing  
39 Conditions during October.

40 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
41 River were examined during the September and October adult fall-run Chinook salmon upstream

1 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
2 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
3 H3 would be 6% and 12% higher than those under Existing Conditions during September and  
4 October, respectively.

### 5 **Stanislaus River**

#### 6 *Fall-Run*

7 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
8 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under H3 throughout this period would generally  
10 be lower than Existing Conditions (up to 36% lower), except in wet water years, in which flows  
11 would be similar or up to 8% greater than flows under Existing Conditions.

12 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
13 River were examined during the February through May juvenile fall-run Chinook salmon migration  
14 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
15 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 6%  
16 higher than those under Existing Conditions in every month of the period.

17 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
18 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
19 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would be up to 17% lower than  
20 flows under Existing Conditions.

21 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
22 River were examined during the September and October adult fall-run Chinook salmon upstream  
23 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
24 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
25 H3 would be 6% higher than those under Existing Conditions during September but there would be  
26 no difference in mean monthly water temperatures between H3 and Existing Conditions during  
27 October.

### 28 **San Joaquin River**

#### 29 *Fall-Run*

30 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
31 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
32 *Analysis*). Mean monthly flows under H3 would generally be similar to flows under Existing  
33 Conditions in all months. Wetter water years under H3 would have similar or greater flows than  
34 those under Existing Conditions, whereas drier years would have lower flows under H3.

35 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
36 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
37 *in the Fish Analysis*). Mean monthly flows under H3 would be 8% lower than those under Existing  
38 Conditions in September and similar in October.

39 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 *Fall-Run*

3 Flows in the Mokelumne River at the Delta were examined during the February through May  
4 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
5 *the Fish Analysis*). Flows under H3 would be similar to or up to 15% greater than those under  
6 Existing Conditions during February and March, but up to 18% lower than flows under Existing  
7 Conditions during April and May.

8 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
9 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
10 *in the Fish Analysis*). Flows under H3 would be 27% lower than under Existing Conditions during  
11 September but would be similar during October.

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **H1/LOS**

14 **Sacramento River**

15 *Fall-Run*

16 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
17 during the February through May juvenile fall-run Chinook salmon migration period. Flows under  
18 H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in*  
19 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
20 between Existing Conditions and H1 in any month throughout the period, except in wet water years  
21 during May (5% increase) (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
22 *Temperature Model Results utilized in the Fish Analysis*).

23 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
24 during the September through October adult fall-run Chinook salmon upstream migration period.  
25 Flows under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
26 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 5% and  
27 6% greater than those under Existing Conditions during September and October, respectively  
28 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
29 *utilized in the Fish Analysis*).

30 Due to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
31 those for H3.

32 *Late Fall-Run*

33 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
34 during the January through March juvenile late fall-run Chinook salmon emigration period. Mean  
35 monthly flows under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
36 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
37 water temperature between Existing Conditions and H1 in any month or water year type, except in  
38 critical years during January (5% higher). (Appendix 11D, *Sacramento River Water Quality Model*  
39 *and Reclamation Temperature Model Results utilized in the Fish Analysis*).

1 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
2 during the December through February adult late fall-run Chinook salmon migration period. Mean  
3 monthly flows under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
5 water temperature between Existing Conditions and H1 in any month throughout the period, except  
6 in critical years during January (5% higher) (Appendix 11D, *Sacramento River Water Quality Model*  
7 *and Reclamation Temperature Model Results utilized in the Fish Analysis*).

8 Due to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
9 those for H3.

### 10 **Clear Creek**

#### 11 *Fall-Run*

12 Flows in the Clear Creek below Whiskeytown Reservoir during February through May under H1  
13 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
14 *Fish Analysis*). Flows in the Clear Creek below Whiskeytown Reservoir during September through  
15 October under H1 would generally be similar to flows under H3. Due to similar flows between H1  
16 and H3, results for H1 would be similar to those for H3.

17 Water temperature modeling was not conducted in Clear Creek.

### 18 **Feather River**

19 Water temperatures under H1 would be similar to flows under H3.

#### 20 *Fall-Run*

21 Mean monthly flows and water temperatures in the Feather River at the confluence with the  
22 Sacramento River were examined during the February through May juvenile fall-run Chinook  
23 salmon migration period. Flows under H1 would be similar to flows under H3 (Appendix 11C,  
24 *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean  
25 monthly water temperature between Existing Conditions and H1 in any month throughout the  
26 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
27 *Results utilized in the Fish Analysis*).

28 Mean monthly flows and water temperatures in the Feather River at the confluence with the  
29 Sacramento River were examined during the September through October fall-run Chinook salmon  
30 adult upstream migration period. Flows under H1 would be similar to flows under H3 except in wet  
31 and above normal water years during September during which flows would be 65% and 40% lower  
32 than flows under H3, respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
33 *Analysis*). Although large reductions, they occur in the wettest water year types and, therefore, are  
34 not expected to have biologically meaningful effects on fall-run Chinook salmon. Mean monthly  
35 water temperatures during September would be 6% higher under H1 than under Existing  
36 Conditions, but there would be no differences during October (Appendix 11D, *Sacramento River*  
37 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

1 **American River**

2 *Fall-Run*

3 Mean monthly flows and water temperatures in the American River at the confluence with the  
4 Sacramento River were examined during the February through May juvenile fall-run Chinook  
5 salmon migration period. Flows under H1 would generally be similar to flows under H3 (Appendix  
6 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
7 H1 would be 5% to 7% higher than under Existing Conditions in all month except April, in which  
8 there would be no difference (Appendix 11D, *Sacramento River Water Quality Model and*  
9 *Reclamation Temperature Model Results utilized in the Fish Analysis*).

10 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
11 River were examined during the September and October adult fall-run Chinook salmon upstream  
12 migration period. Flows during September through October under H1 would generally be similar to  
13 flows under H3 except in wet and above normal water years during September during which flows  
14 would be 38% and 19% lower than flows under H3, respectively (Appendix 11C, *CALSIM II Model*  
15 *Results utilized in the Fish Analysis*). Although small to moderate reductions, they occur in the  
16 wettest water year types and, therefore, are not expected to have biologically meaningful effects on  
17 fall-run Chinook salmon. Mean monthly water temperatures under H1 would be 7% and 10% higher  
18 than those under Existing Conditions during September and October, respectively (Appendix 11D,  
19 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
20 *Fish Analysis*).

21 **Stanislaus River**

22 *Fall-Run*

23 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
24 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
25 *Model Results utilized in the Fish Analysis*). Flows under H1 throughout this period would generally  
26 be lower than Existing Conditions (up to 36% lower), except in wet water years, in which flows  
27 would be similar or up to 7% greater than flows under Existing Conditions.

28 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
29 River were examined during the February through May juvenile fall-run Chinook salmon migration  
30 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
31 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 6%  
32 higher than those under Existing Conditions in every month of the period.

33 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
34 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would be up to 17% lower than  
36 flows under Existing Conditions.

37 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
38 River were examined during the September and October adult fall-run Chinook salmon upstream  
39 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
40 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
41 H1 would be 6% higher than those under Existing Conditions during September but there would be

1 no difference in mean monthly water temperatures between H1 and Existing Conditions during  
2 October.

3 Flows and water temperatures in the Stanislaus River would be similar between H1 and H3.  
4 Therefore, results for H1 would be similar to those for H3.

5 ***San Joaquin River***

6 *Fall-Run*

7 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
8 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
9 *Analysis*). Mean monthly flows under H1 would generally be similar to flows under Existing  
10 Conditions in all months. Wetter water years under H1 would have similar or greater flows than  
11 those under Existing Conditions, whereas drier years would have lower flows under H1.

12 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
13 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
14 *in the Fish Analysis*). Mean monthly flows under H1 would be 8% and 5% lower than those under  
15 Existing Conditions in September and October, respectively.

16 Water temperature modeling was not conducted in the San Joaquin River.

17 Flows in the San Joaquin River would generally be similar between H1 and H3. Therefore, results for  
18 H1 would be similar to those for H3

19 ***Mokelumne River***

20 *Fall-Run*

21 Flows in the Mokelumne River at the Delta were examined during the February through May  
22 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
23 *the Fish Analysis*). Flows under H1 would be similar to or up to 15% higher than those under  
24 Existing Conditions during February and March, but up to 18% lower than flows under Existing  
25 Conditions during April and May.

26 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
27 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
28 *in the Fish Analysis*). Flows under H1 would be 27% lower than under Existing Conditions during  
29 September but would be similar during October.

30 Water temperature modeling was not conducted in the Mokelumne River.

31 Flows in the Mokelumne River would be similar between H1 and H3. Therefore, results for H1  
32 would be similar to those for H3.

1 **H4/HOS**

2 ***Sacramento River***

3 *Fall-Run*

4 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
5 during the February through May juvenile fall-run Chinook salmon migration period. Flows under  
6 H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in*  
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature  
8 between Existing Conditions and H4 in any month throughout the period, except in wet water years  
9 during May (5% increase) (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
10 *Temperature Model Results utilized in the Fish Analysis*).

11 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
12 during the September through October adult fall-run Chinook salmon upstream migration period.  
13 Flows under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
14 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would not be  
15 different from those under Existing Conditions during September but would be 6% greater than  
16 those under Existing Conditions during October (Appendix 11D, *Sacramento River Water Quality*  
17 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

18 Due to generally similar flows and water temperatures between H4 and H3, results for H4 would be  
19 similar to those for H3.

20 *Late Fall-Run*

21 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
22 during the January through March juvenile late fall-run Chinook salmon emigration period. Mean  
23 monthly flows under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
24 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in water  
25 temperature between Existing Conditions and H4 in any month or water year type. (Appendix 11D,  
26 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
27 *Fish Analysis*).

28 Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined  
29 during the December through February adult late fall-run Chinook salmon migration period. Mean  
30 monthly flows under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
31 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
32 water temperature between Existing Conditions and H4 in any month throughout the period  
33 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
34 *utilized in the Fish Analysis*).

35 Due to similar flows and water temperatures between H4 and H3, results for H4 would be similar to  
36 those for H3.

37 ***Clear Creek***

38 *Fall-Run*

39 Flows in the Clear Creek below Whiskeytown Reservoir during February through May under H4  
40 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*

1 *Fish Analysis*). Flows in the Clear Creek below Whiskeytown Reservoir during September through  
2 October under H4 would generally be similar to flows under H3. Due to similar flows between H4  
3 and H3, results for H4 would be similar to those for H3.

4 Water temperature modeling was not conducted in Clear Creek.

5 ***Feather River***

6 Water temperatures under H4 would be similar to flows under H3.

7 ***Fall-Run***

8 Mean monthly flows and water temperatures in the Feather River at the confluence with the  
9 Sacramento River were examined during the February through May juvenile fall-run Chinook  
10 salmon migration period. Flows under H4 would be similar to or greater than flows under H3  
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences  
12 (<5%) in mean monthly water temperature between Existing Conditions and H4 in any month  
13 throughout the period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
14 *Temperature Model Results utilized in the Fish Analysis*).

15 Mean monthly flows and water temperatures in the Feather River at the confluence with the  
16 Sacramento River were examined during the September through October fall-run Chinook salmon  
17 adult upstream migration period. Flows under H4 would be higher than, similar to, or lower than  
18 flows under H3 depending on month and water year type (Appendix 11C, *CALSIM II Model Results*  
19 *utilized in the Fish Analysis*). On average, flows would be 5% and 6% lower under H4 relative to H3  
20 in September, and October, respectively. These reductions would not be of high enough magnitude  
21 to have a biologically meaningful effect on fall-run Chinook salmon adult migration. Mean monthly  
22 water temperatures under H4 would be similar to those under Existing Conditions during  
23 September, but 5% higher during October (Appendix 11D, *Sacramento River Water Quality Model*  
24 *and Reclamation Temperature Model Results utilized in the Fish Analysis*).

25 ***American River***

26 ***Fall-Run***

27 Mean monthly flows and water temperatures in the American River at the confluence with the  
28 Sacramento River were examined during the February through May juvenile fall-run Chinook  
29 salmon migration period. Flows under H4 would generally be similar to flows under H3 (Appendix  
30 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
31 H4 would be 5% to 7% higher than under Existing Conditions in all month except April, in which  
32 there would be no difference (Appendix 11D, *Sacramento River Water Quality Model and*  
33 *Reclamation Temperature Model Results utilized in the Fish Analysis*).

34 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
35 River were examined during the September and October adult fall-run Chinook salmon upstream  
36 migration period. Flows under H4 would generally be greater than flows under H3 during September  
37 and generally lower than flows under H3 during October depending on water year type (Appendix  
38 11C, *CALSIM II Model Results utilized in the Fish Analysis*). On average, flows under H4 would be 16%  
39 higher during September and 8% lower during October. The September increase would have a small  
40 to moderate biologically meaningful effect on fall-run Chinook salmon adult migration although  
41 October decrease would be too small to have a biologically meaningful effect. Mean monthly water  
42 temperatures under H4 would be 6% and 11% higher than those under Existing Conditions during

1 September and October, respectively (Appendix 11D, *Sacramento River Water Quality Model and*  
2 *Reclamation Temperature Model Results utilized in the Fish Analysis*).

### 3 **Stanislaus River**

#### 4 *Fall-Run*

5 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
6 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*  
7 *Model Results utilized in the Fish Analysis*). Flows under H4 throughout this period would generally  
8 be lower than Existing Conditions (up to 36% lower), except in wet water years, in which flows  
9 would be similar or up to 7% greater than flows under Existing Conditions.

10 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
11 River were examined during the February through May juvenile fall-run Chinook salmon migration  
12 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
13 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 6%  
14 higher than those under Existing Conditions in every month of the period.

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
16 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,  
17 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would be up to 17% lower than  
18 flows under Existing Conditions.

19 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
20 River were examined during the September and October adult fall-run Chinook salmon upstream  
21 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*  
22 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under  
23 H4 would be 6% higher than those under Existing Conditions during September but there would be  
24 no difference in mean monthly water temperatures between H4 and Existing Conditions during  
25 October.

26 Flows and water temperatures in the Stanislaus River would be similar between H4 and H3.  
27 Therefore, results for H4 would be similar to those for H3.

### 28 **San Joaquin River**

#### 29 *Fall-Run*

30 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile  
31 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
32 *Analysis*). Mean monthly flows under H4 would generally be similar to flows under Existing  
33 Conditions in all months. Wetter water years under H4 would have similar or greater flows than  
34 those under Existing Conditions, whereas drier years would have lower flows under H4.

35 Flows in the San Joaquin River at Vernalis were examined during the September and October adult  
36 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
37 *in the Fish Analysis*). Mean monthly flows under H4 would be 8% lower than those under Existing  
38 Conditions in September but similar during October, respectively.

39 Water temperature modeling was not conducted in the San Joaquin River.

1 Flows in the San Joaquin River would be generally similar between H4 and H3. Therefore, results for  
2 H4 would be similar to those for H3.

### 3 **Mokelumne River**

#### 4 *Fall-Run*

5 Flows in the Mokelumne River at the Delta were examined during the February through May  
6 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*  
7 *the Fish Analysis*). Flows under H4 would be similar to or up to 15% higher than those under  
8 Existing Conditions during February and March, but up to 18% lower than flows under Existing  
9 Conditions during April and May.

10 Flows in the Mokelumne River at the Delta were examined during the September and October adult  
11 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*  
12 *in the Fish Analysis*). Flows under H4 would be 27% lower than under Existing Conditions during  
13 September but would be similar during October.

14 Water temperature modeling was not conducted in the Mokelumne River.

15 Flows in the Mokelumne River would be similar between H4 and H3. Therefore, results for H4  
16 would be similar to those for H3.

### 17 **Through-Delta**

#### 18 **Sacramento River**

##### 19 *Fall-Run*

##### 20 *Juveniles*

21 As described above, Scenario H3 operations would reduce overall OMR reverse flows and reduce  
22 Sacramento River flows below the north Delta diversions (Appendix 11C, *CALSIM II Model Results*  
23 *utilized in the Fish Analysis*). Survival of Sacramento River juveniles under Scenarios H3 and H1  
24 averaged for all years was similar to Existing Conditions, with a slight increase in drier years (about  
25 1% greater, or a 5% relative difference) and about 5% decrease (a 16% relative difference) in  
26 wetter years (Table 11-4-74). Under Scenario H4 average survival was similar (1% relative  
27 decrease) to Existing Conditions for all years, drier years and wetter years.

##### 28 *Adults*

29 The percentage of Sacramento River origin flow at Collinsville, would be slightly increased (3–7% in  
30 September to November) under Scenario H3 compared to Existing Conditions (Table 11-4-75). This  
31 would not significantly affect olfactory cues for adults migrating to the Sacramento River because  
32 the change is less than 10%.

##### 33 *Late Fall-Run*

##### 34 *Juveniles*

35 As described above, Alternative 4 operations would reduce OMR reverse flows and reduce  
36 Sacramento River flows below the north Delta diversions (Appendix 11C, *CALSIM II Model Results*  
37 *utilized in the Fish Analysis*). Conditions under Scenario H4 would further improve OMR flow

1 conditions relative to the Scenario H3 and LOS. As estimated by DPM, through-Delta survival by  
2 emigrating juvenile late fall-run Chinook salmon under Scenario H3 was slightly increased averaged  
3 across all years (0.5% greater survival, a 2% relative difference) compared to Existing Conditions  
4 (Table 11-4-76). Survival was greater in drier years (1.7% increase, a 9% relative difference) but  
5 reduced in wetter years (1.4%, a 5% relative difference).

#### 6 *Adults*

7 As described above, the percentage of Sacramento River water would be slightly reduced in  
8 December and March (1% to 10% less) compared to NAA (Table 11-4-75). This effect would be less  
9 under Scenario H4 compared to Scenarios H3 and H1 due to reduced north Delta exports. Olfactory  
10 cues would be slightly decreased, but the impact would be less minor because flow changes are than  
11 10% for the bulk of the late fall-run migration.

12 Overall, the impact on migration conditions from Alternative 4 operations (Scenarios H3, H1 and  
13 H4) is considered less than significant due to similar juvenile survival during all water year types  
14 and minor effect on olfactory cues.

15 Overall, conditions would be similar across all flow scenarios under Alternative 4. No mitigation  
16 would be required.

#### 17 ***Mokelumne River***

##### 18 *Fall-Run*

19 Through-Delta survival of emigrating juveniles estimated by DPM under Alternative 4 operations  
20 (Scenarios H3, H1, and H4) was similar to Existing Conditions for all years, drier years, and wetter  
21 years (less than 1% absolute difference in survival, and no more than 5% relative difference) (Table  
22 11-4-74).

#### 23 ***San Joaquin River***

##### 24 *Fall-Run*

##### 25 *Juveniles*

26 Under Alternative 4 (all operation Scenarios H3, H1 and H4), mean survival of juveniles migrating  
27 from the San Joaquin River averaged around 13% (Table 11-4-74). Alternative 4 survival was  
28 similar to Existing Conditions for all years (less than 1% absolute difference, a 2–4% relative  
29 difference). Survival was slightly greater in drier years (about 1 % greater survival, or 10% more in  
30 relative difference) and slightly reduced in wetter years (about 2% decrease, or 12–13% less in  
31 relative difference).

##### 32 *Adults*

33 As described above, the percentage of San Joaquin River water is very small (no more than 1%  
34 under NAA) during the fall-run migration period (September to December). Under Scenario H3  
35 operations, this would increase by 1–3% in September and October, 4.5% in November, and 2% in  
36 December (Table 11-4-75). Olfactory cues for adults migrating to the San Joaquin River would be  
37 slightly increased under all flows scenarios for Alternative 4.

1 **Summary of CEQA Conclusion**

2 Collectively, these results indicate that the impact is less than significant because movement  
3 conditions would not be substantially reduced, and no mitigation is necessary. Flows under  
4 Alternative 4 would generally be similar to or higher than flows under Existing Conditions in all  
5 rivers except the American River. In the American River, there would be flow reductions during half  
6 of the adult migration period. However, these flow reductions are not expected to affect the fall-run  
7 population at a population scale. These results would be similar among scenarios. The impact of  
8 Alternative 4 across the operational range (Scenarios H3, H1 low outflow, and H4 high outflow) on  
9 through-Delta migration conditions would be negligible due to similar juvenile survival and minor  
10 effect on olfactory cues for adults. Similarly, the impact on the fall-run Chinook salmon commercial  
11 fishery would be less than significant. No mitigation would be required.

12 **Restoration Measures (CM2, CM4–CM7, and CM10)**

13 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
14 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
15 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
16 restoration measures described for fall- and late fall-run Chinook salmon under Alternative 1A  
17 (Impacts AQUA-79 through AQUA-81) also appropriately characterize effects under Alternative 4.

18 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

19 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-  
20 /Late Fall–Run ESU)**

21 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook  
22 Salmon (Fall-/Late Fall–Run ESU)**

23 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-  
24 Run ESU)**

25 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms  
26 on fall- and late fall-run Chinook salmon are the same as those described under Alternative 1A  
27 (Impacts AQUA-79 through AQUA-81). The effects would not be adverse, and would generally be  
28 beneficial. Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook  
29 salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects  
30 of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

31 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or  
32 less than significant, and no mitigation is required.

33 **Other Conservation Measures (CM12–CM19 and CM21)**

34 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
35 differences in other conservation-related fish effects are anticipated anywhere in the affected  
36 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
37 effects of other conservation measures described for fall- and late fall-run Chinook salmon under  
38 Alternative 1A (Impacts AQUA-82 through AQUA-90) also appropriately characterize effects under  
39 Alternative 4.

1 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

2 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**  
3 **Run ESU) (CM12)**

4 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**  
5 **(Fall-/Late Fall-Run ESU) (CM13)**

6 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**  
7 **/Late Fall-Run ESU) (CM14)**

8 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-**  
9 **/Late Fall-Run ESU) (CM15)**

10 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**  
11 **Run ESU) (CM16)**

12 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**  
13 **ESU) (CM17)**

14 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**  
15 **ESU) (CM18)**

16 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**  
17 **Fall-Run ESU) (CM19)**

18 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**  
19 **(Fall-/Late Fall-Run ESU) (CM21)**

20 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms  
21 on fall-run and late fall-run Chinook salmon are the same as those described under Alternative 1A  
22 (Impacts AQUA-82 through AQUA-90). The effects range from no effect, to not adverse, to beneficial.

23 *CEQA Conclusion:* The effects of the nine impact mechanisms listed above range from no impact, to  
24 less than significant, to beneficial, and no mitigation is required.

## 25 **Steelhead**

### 26 **Construction and Maintenance of CM1**

#### 27 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

28 The potential effects of construction of the water conveyance facilities on steelhead would be similar  
29 to those described for Alternative 1A, Impact AQUA-91, except Alternative 4 would include three  
30 intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less  
31 under this alternative. This would convert about 6,360 lineal feet of existing shoreline habitat into  
32 intake facility structures and would require about 17.1 acres of dredge and channel reshaping. In  
33 contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and would require 27.3 acres  
34 of dredging. Alternative 4 would use five barge locations rather than six as under Alternative 1A so  
35 those effects would also be proportionally less. Additionally, construction and excavation at Clifton

1 Court Forebay would be done in the dry via installation of cofferdams for isolation and dewatering  
2 of work areas. Implementation of Appendix 3B, *Environmental Commitments*, including construction  
3 BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize adverse effects as described for  
4 Alternative 1A. Mitigation measures would also be available to avoid and minimize potential effects.

5 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-91, the effect would not be adverse for  
6 steelhead.

7 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-91, the impact of the construction of  
8 the water conveyance facilities on steelhead would not be significant except for construction noise  
9 associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
10 because only three intakes would be constructed rather than five. Implementation of Mitigation  
11 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
12 significant.

13 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
14 **of Pile Driving and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
16 Alternative 1A.

17 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
18 **and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
20 Alternative 1A.

21 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

22 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
23 Alternative 4 would be the same as those described for Alternative 1A, Impact AQUA-92, except that  
24 only three intakes would be maintained under Alternative 4 rather than five under Alternative 1A.  
25 As concluded in Impact AQUA-92, the impact would not be adverse for steelhead.

26 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance  
27 of water conveyance facilities on steelhead would be less than significant and no mitigation is  
28 required.

29 **Water Operations of CM1**

30 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

31 **Water Exports from SWP/CVP South Delta Facilities**

32 Alternative 4 south Delta export facilities, as estimated by the salvage density method, by about 51%  
33 (~4,500 fish; Table 11-4-77) across all years compared to NAA. Losses under Scenario H3 would be  
34 greatest in below normal (~7,500 fish) and lowest in wet water years (~2,000 fish). Conditions  
35 under Scenario H1 would be similar to Scenario H3, while conditions under Scenario H4 would  
36 further reduce entrainment loss at the south Delta facilities due to decreased exports.

1 **Table 11-4-77. Juvenile Steelhead Annual Entrainment at the SWP and CVP Salvage Facilities—**  
2 **Differences between Model Scenarios for Alternative 4 (Scenario H3)**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-4,179 (-67%)	-4,271 (-68%)
Above Normal	-7,045 (-54%)	-7,389 (-55%)
Below Normal	-4,368 (-37%)	-3,638 (-33%)
Dry	-2,181 (-29%)	-1,591 (-23%)
Critical	-1,208 (-21%)	-858 (-16%)
All Years	-4,648 (-52%)	-4,506 (-51%)

Shading indicates 10% or greater increased entrainment.

Note: Estimated annual number of fish lost, based on normalized data.

3

4 ***Water Exports from SWP/CVP North Delta Intake Facilities***

5 The impact would be similar in type to Alternative 1A, Impact AQUA-93, but the degree would be  
6 less because Alternative 4 would have fewer intakes, therefore, under Alternative 4 there would be  
7 about a 40% reduction in impingement and predation risk relative to Alternative 1A.

8 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

9 The impact and conclusion are the same as for Alternative 1A (Impact AQUA-93). Entrainment and  
10 impingement effects on juvenile steelhead would be minimal for Alternative 4 because intakes  
11 would have state-of-the-art screens installed.

12 ***Predation Associated with Entrainment***

13 Entrainment-related predation loss at the south Delta facilities would be no greater and may be  
14 lower than baseline (NAA), due to a reduction in entrainment. Conditions under Scenario H4 would  
15 further reduce entrainment-related predation loss compared to Scenario H3, while conditions under  
16 Scenario H1 would be similar to Scenario H3.

17 Predation at the north Delta would be increased due to the construction of the proposed SWP/CVP  
18 water export facilities on the Sacramento River. It is assumed that per capita steelhead predation  
19 losses would be similar to those predicted for spring-run Chinook salmon, although slightly reduced  
20 because of the larger size of steelhead outmigrants. Bioenergetics modeling with a median predator  
21 density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a predation loss of  
22 about 0.2% of the juvenile spring-run juvenile population (Table 11-4-30).

23 ***NEPA Effects:*** In conclusion, operations under Alternative 4 under all flow scenarios (e.g., H3, H1,  
24 H4) would reduce entrainment at the south Delta facilities and minimize or avoid entrainment with  
25 screens at the north Delta intakes and NBA alternative intake. Predation loss at the south Delta  
26 would be reduced and predation at the north Delta intakes would likely have a very minor impact on  
27 the overall steelhead population. The overall effect under Alternative 4 would not be adverse.

28 ***CEQA Conclusion:*** As described above, entrainment losses of juvenile steelhead would decrease  
29 under Alternative 4 (A4\_LL1) compared to existing biological conditions at the south Delta export  
30 facilities (Table 11-4-77). The screened intakes of the north Delta diversion and NBA alternative

1 intake, as designed, would exclude juvenile salmonids. The impact of predation associated with  
2 entrainment would be the same as described above as predation loss at the south Delta (no greater  
3 and possibly lower compared with Existing Conditions), but increased slightly at the north Delta  
4 intakes. There would likely be a minor increase in predation loss under Alternative 4, but the  
5 population level effect would likely be small. Entrainment loss under Scenario H4 is expected to be  
6 less compared to Scenario H3 and Scenario H1. Overall, the impact would be less than significant, no  
7 mitigation is required.

### 8 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 9 **Steelhead**

10 In general, Alternative 4 would have negligible effects on spawning and egg incubation habitat for  
11 steelhead relative to the NAA.

### 12 **H3/ESO**

#### 13 ***Sacramento River***

14 The primary steelhead spawning and egg incubation period extends from January through April.  
15 Results of the CALSIM analyses of instream flows within the reach where the majority of steelhead  
16 spawning occurs (Keswick Dam to upstream of RBDD) were summarized by month and water-year  
17 type based on estimated flows at RBDD (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
18 *Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and  
19 rapid reductions in flow can expose redds leading to mortality. Mean monthly flows under H3 would  
20 be similar to those under NAA, except for a small increase in mean monthly flow during February in  
21 below normal years (6%). Overall results indicate negligible project-related effects on flow.

22 SacEFT predicts that there would be negligible differences ( $\leq 5\%$ ) between NAA and H3 in spawning  
23 metrics including percentage of years with good spawning availability, measured as weighted usable  
24 area, redd scour risk, percentage of years with good (lower) egg incubation conditions, and redd  
25 dewatering risk. Results indicate negligible project-related effects on steelhead habitat metrics  
26 related to spawning and egg incubation in the Sacramento River.

27 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
28 examined during the January through April primary steelhead spawning and egg incubation period  
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
30 *utilized in the Fish Analysis*). There would be no differences ( $< 5\%$ ) in mean monthly water  
31 temperature between NAA and H3 in any month or water year type throughout the period at either  
32 location. Based on negligible effects ( $\leq 5\%$ ) on mean monthly flow, SacEFT metrics related to  
33 spawning and egg incubation, and water temperature conditions compared to NAA, project-related  
34 effects of H3 on flow would not affect steelhead spawning conditions in the Sacramento River.

1 **Table 11-4-78. Difference and Percent Difference in Percentage of Years with “Good” Conditions**  
2 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. H3	NAA vs. H3
Spawning WUA	-2 (-4%)	-5 (-10%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	0 (0%)	3 (6%)
Juvenile Rearing WUA	-6 (-15%)	-10 (-22%)
Juvenile Stranding Risk	-12 (-35%)	2 (10%)

WUA = Weighted Usable Area.

3

4 **Clear Creek**

5 The primary spawning and egg incubation period for Clear Creek is January through April. Results of  
6 the CALSIM analyses of instream flows for the Clear Creek were summarized by month and water-  
7 year type for January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and  
9 rapid reductions in flow can expose redds leading to mortality.

10 Flows in Clear Creek during January through April under H3 would generally be similar to those  
11 under NAA. Therefore, H3 would have negligible effects on mean monthly flows in Clear Creek for  
12 the primary steelhead spawning and egg incubation period of January to April.

13 Redd dewatering risk was evaluated for Clear Creek based on flow reductions for each month during  
14 the incubation period (January through April); results are summarized in Table 11-4-79. The  
15 greatest monthly reduction in flows under H3 would be similar to that under NAA.

16 No water temperature modeling was conducted in Clear Creek.

17 Based on mean monthly flows and flow reductions, there would be no effects of H3 on steelhead  
18 spawning and egg incubation habitat conditions.

19 **Table 11-4-79. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**  
20 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**  
21 **Incubation Period<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

22

1 **Feather River**

2 Effects of H3 on flow during the spawning and egg incubation period (January through April) in the  
3 Feather River were evaluated using the results of CALSIM analyses of instream flows within the  
4 reach where the majority of steelhead spawning occurs (low-flow channel) based on estimated  
5 flows above Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Flows in the high-flow channel were characterized based on information in the Feather  
7 River at Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
8 Lower flows can reduce the instream area available for spawning and egg incubation, and rapid  
9 reductions in flow can expose redds leading to mortality.

10 Flows in the Feather River high-flow channel during January through April under H3 would be  
11 similar to or greater than flows under NAA, with few exceptions. The increases in flow would have  
12 beneficial effects of varying magnitudes on spawning and egg incubation habitat in all water year  
13 types.

14 Steelhead spawning and egg incubation on the Feather River occurs primarily in Hatchery Ditch and  
15 the low-flow channel in the general vicinity of the Feather River Hatchery. Instream flows affect  
16 physical habitat quality and availability through changes in wetted channel width, water depth, and  
17 water velocities. Results of IFIM studies (WUA versus flow relationships) provide information on the  
18 spawning habitat conditions in the low-flow channel. Results of CALSIM modeling show that  
19 instream flows in the Feather River low-flow channel were the same for NAA and H3 regardless of  
20 month and water year type and range from 700 to 800 cfs under all conditions (Appendix 11C,  
21 *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, H3 is not expected to affect physical  
22 habitat conditions for steelhead spawning and egg incubation within the Feather River low-flow  
23 channel.

24 Water temperatures in the low-flow channel of the Feather River are determined largely by cold  
25 water pool storage in Oroville Reservoir and instream flow releases. Because instream flows in the  
26 low-flow channel would be the same under H3 and NAA, any simulated changes in water  
27 temperatures under H3 would be attributed to changes in reservoir storage. Reservoir storage in  
28 May and September provides an indicator of cold water pool availability. May Oroville storage  
29 volume under H3 would be similar to storage under NAA in all water year types (Table 11-4-45).  
30 September Oroville storage volume under H3 would be similar to volume in wet, above normal, and  
31 below normal water years and 11% to 18% greater than volume under NAA during dry and critical  
32 water years (Table 11-4-39).

33 Effects of H3 on water temperature-related spawning and egg incubation conditions for steelhead in  
34 the Feather River were analyzed by comparing the percent of months between January through  
35 April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold in the  
36 low-flow channel (above Thermalito Afterbay) (Table 11-4-80). Differences in the percent of months  
37 exceeding the threshold between NAA and H3 would be negligible (<5% on an absolute scale).

1 **Table 11-4-80. Differences between Baseline and H3 Scenarios in Percent of Months during the**  
 2 **82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River above**  
 3 **Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	10 (800%)	2 (NA)	1 (NA)	1 (NA)	1 (NA)
April	44 (514%)	23 (475%)	15 (NA)	7 (NA)	2 (NA)
<b>NAA vs. H3</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	1 (13%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	0 (0%)	-4 (-12%)	-2 (-14%)	1 (20%)	1 (100%)

NA = could not be calculated because the denominator was 0.

4  
 5 The effects of H3 on water temperature-related spawning and egg incubation conditions for  
 6 steelhead in the Feather River were also analyzed by comparing the total degree-months for months  
 7 that exceed the 56°F NMFS threshold during the January through April steelhead spawning period for  
 8 all 82 years (Table 11-4-81). There would be no difference (<5% on a relative scale) in total degree-  
 9 months exceeded between NAA and H3 for any month or water year type.

10 Overall for the Feather River, these results indicate that the effects of H3 on flow and water  
 11 temperatures would not affect steelhead spawning conditions in the Feather River.

1 **Table 11-4-81. Differences between Baseline and H3 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**  
 3 **the Feather River above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	3 (NA)	1 (50%)
	Critical	8 (800%)	0 (0%)
	All	13 (1,300%)	1 (8%)
April	Wet	4 (NA)	1 (33%)
	Above Normal	12 (600%)	1 (8%)
	Below Normal	15 (375%)	-1 (-5%)
	Dry	24 (480%)	-2 (-6%)
	Critical	20 (NA)	-3 (-13%)
	All	75 (682%)	-4 (-4%)

NA = could not be calculated because the denominator was 0.

4

5 **American River**

6 The primary steelhead spawning and egg incubation period for the American River extends from  
 7 January through April. Results of the CALSIM analyses of instream flows within the lower American  
 8 River at the confluence with the Sacramento River were summarized by month and water-year type  
 9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the  
 10 instream area available for spawning and egg incubation and rapid reductions in flow can dewater  
 11 redds leading to mortality. Mean monthly flows under H3 would be similar to flows under NAA  
 12 during all months and water year types with few exceptions.

13 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
 14 during the January through April steelhead spawning and egg incubation period (Appendix 11D,  
 15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
 17 NAA and H3 in any month or water year type throughout the period.

1 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
2 Avenue Bridge was evaluated during November through April (Table 11-4-64). Steelhead spawn and  
3 eggs incubate in the American River between January and April. During this period, the percent of  
4 months exceeding the threshold under H3 would similar to or up to 5% lower (absolute scale) than  
5 the percent under NAA.

6 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
7 Avenue Bridge during November through April (Table 11-4-65). During the January through April  
8 steelhead spawning and egg incubation period, total degree-months would be similar between NAA  
9 and H3.

10 Based on mean monthly flows and water temperature effects, effects under H3 in the American  
11 River would consist primarily of negligible effects (<5%) on mean monthly flows and water  
12 temperatures and would not have biologically meaningful effects on steelhead spawning and egg  
13 incubation conditions in the American River.

#### 14 **Stanislaus River**

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
16 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
17 *Model Results utilized in the Fish Analysis*). Flows under H3 throughout this period would generally  
18 be identical to flows under NAA.

19 Water temperatures throughout the Stanislaus River would be similar under NAA and H3  
20 throughout the January through April steelhead spawning and egg incubation period (Appendix  
21 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*  
22 *the Fish Analysis*).

#### 23 **San Joaquin River**

24 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 25 **Mokelumne River**

26 Flows in the Mokelumne River at the Delta were examined during the January through April  
27 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
28 *Fish Analysis*). Flows under H3 throughout this period would generally be identical to flows under  
29 NAA.

30 Water temperature modeling was not conducted in the Mokelumne River.

#### 31 **H1/LOS**

#### 32 **Sacramento River**

33 Flows in the Sacramento River at Keswick and upstream of Red Bluff during January through April  
34 under H1 would generally be similar to or greater than flows under H3 (Appendix 11C, *CALSIM II*  
35 *Model Results utilized in the Fish Analysis*). Water temperatures would be similar between H1 and  
36 H3. Due to similar flows and water temperatures between H1 and H3, results for additional analyses  
37 (e.g., SacEFT) under H1 would be similar to results for analyses under H3. As a result, these  
38 additional analyses were not conducted for H1. Overall, results for H1 would be similar to or better  
39 than those for H3.

1 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
2 during the January through April steelhead spawning and egg incubation period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 NAA and H1 in any month or water year type throughout the period.

6 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
7 Avenue Bridge was evaluated during November through April (Table 11-4-71). Steelhead spawn and  
8 eggs incubate in the American River between January and April. During this period, the percent of  
9 months exceeding the threshold under H1 would similar to or up to 11% lower (absolute scale) than  
10 the percent under NAA.

11 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
12 Avenue Bridge during November through April (Table 11-4-72). During the January through April  
13 steelhead spawning and egg incubation period, total degree-months would be similar between NAA  
14 and H1.

### 15 **Clear Creek**

16 Flows in the Clear Creek during January through April under H1 would generally be similar to flows  
17 under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water  
18 temperature modeling was conducted in Clear Creek. Due to similar flows between H1 and H3,  
19 results for additional analyses (e.g., redd dewatering risk,) under H1 would be similar to results for  
20 analyses under H3. As a result, these additional analyses were not conducted for H1. Overall, results  
21 for H1 would be similar to those for H3.

### 22 **Feather River**

23 Flows in the Feather River above Thermalito Afterbay (low-flow channel) during January through  
24 April under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
25 *Results utilized in the Fish Analysis*). Flows in the Feather River below Thermalito Afterbay (high-  
26 flow channel) during January through April under H1 would generally be similar to or greater than  
27 flows under H3. May and September Oroville storage under H1 would generally be similar to or  
28 greater than storage under H3 (Table 11-4-45, Table 11-4-39).

29 Differences in the percent of months exceeding the 56°F threshold between NAA and H1 would  
30 generally be negligible (<5% on an absolute scale) during January through March (Table 11-4-82).  
31 During April, the percent of months exceeding the threshold under H1 would be similar to or up to  
32 12% lower (absolute scale) than the percent under NAA. This represents a small benefit of H1 to  
33 steelhead spawning habitat conditions in the Feather River.

1 **Table 11-4-82. Differences between Baselines and H1 and H4 Scenarios in Percent of Months**  
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 3 **River above Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	4 (300%)	2 (NA)	1 (NA)	1 (NA)	0 (NA)
April	32 (371%)	16 (325%)	12 (NA)	4 (NA)	1 (NA)
<b>NAA vs. H1</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-5 (-50%)	0 (0%)	0 (0%)	0 (0%)	-1 (-100%)
April	-12 (-23%)	-11 (-35%)	-5 (-29%)	-2 (-40%)	0 (0%)
<b>EXISTING CONDITIONS vs. H4</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	5 (400%)	1 (NA)	1 (NA)	1 (NA)	0 (NA)
April	27 (314%)	14 (275%)	14 (NA)	2 (NA)	1 (NA)
<b>NAA vs. H4</b>					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-4 (-38%)	-1 (-50%)	0 (0%)	0 (0%)	-1 (-100%)
April	-17 (-33%)	-14 (-42%)	-4 (-21%)	-4 (-60%)	0 (0%)

NA = could not be calculated because the denominator was 0.

4

5 Total degree-months above the 56°F threshold under H1 would be similar to (<3 degree months)

6 those under NAA throughout the period regardless of month or water year type (Table 11-4-83).

1  
2  
3

**Table 11-4-83. Differences between Baselines and H1 and H4 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
January	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)	3 (NA)	1 (50%)
	Dry	3 (NA)	1 (50%)	2 (NA)	0 (0%)
	Critical	6 (600%)	-2 (-22%)	7 (700%)	-1 (-11%)
	All	11 (1,100%)	-1 (-8%)	12 (1,200%)	0 (0%)
April	Wet	5 (NA)	2 (67%)	3 (NA)	0 (0%)
	Above Normal	12 (600%)	1 (8%)	6 (300%)	-5 (-38%)
	Below Normal	15 (375%)	-1 (-5%)	11 (275%)	-5 (-25%)
	Dry	23 (460%)	-3 (-10%)	25 (500%)	-1 (-3%)
	Critical	21 (NA)	-2 (-9%)	24 (NA)	1 (4%)
	All	77 (700%)	-2 (-2%)	68 (618%)	-11 (-12%)

NA = could not be calculated because the denominator was 0.

4

5 Due to similar or better flows, reservoir storage, and water temperatures between H1 and H3,  
6 results for H1 would be similar to or better than those for H3.

7 **American River**

8 Flows in the American River at the confluence with the Sacramento River during January through  
9 April under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
10 *Results utilized in the Fish Analysis*). Water temperatures would be similar between H1 and H3. Due  
11 to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
12 those for H3.

1 **H4/HOS**

2 ***Sacramento River***

3 Flows in the Sacramento River at Keswick and upstream of Red Bluff during January through April  
4 under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
5 *utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
7 during the January through April steelhead spawning and egg incubation period (Appendix 11D,  
8 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
9 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
10 NAA and H4 in any month or water year type throughout the period.

11 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
12 Avenue Bridge was evaluated during November through April (Table 11-4-71). Steelhead spawn and  
13 eggs incubate in the American River between January and April. During this period, the percent of  
14 months exceeding the threshold under H4 would similar to or up to 11% lower (absolute scale) than  
15 the percent under NAA.

16 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
17 Avenue Bridge during November through April (Table 11-4-72). During the January through April  
18 steelhead spawning and egg incubation period, total degree-months would be similar between NAA  
19 and H4.

20 Due to similar flows and water temperatures between H4 and H3, results for additional analyses  
21 (e.g., SacEFT) under H4 would be similar to results for analyses under H3. As a result, these  
22 additional analyses were not conducted for H4. Overall, results for H4 would be similar to those for  
23 H3.

24 ***Clear Creek***

25 Flows in the Clear Creek during January through April under H4 would generally be similar to flows  
26 under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water  
27 temperature modeling was conducted in Clear Creek. Due to similar flows between H4 and H3,  
28 results for additional analyses (e.g., redd dewatering risk,) under H4 would be similar to results for  
29 analyses under H3. As a result, these additional analyses were not conducted for H4. Overall, results  
30 for H4 would be similar to those for H3.

31 ***Feather River***

32 Flows in the Feather River above Thermalito Afterbay (low-flow channel) during January through  
33 April under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
34 *Results utilized in the Fish Analysis*). Flows in the Feather River below Thermalito Afterbay (high-  
35 flow channel) during January through April under H4 would generally be similar to or greater than  
36 flows under H3.

37 May storage would be 11% to 15% lower under H4 relative to H3 in wet, above normal, and below  
38 normal water years (Table 11-4-39). September Oroville storage under H4 would generally be  
39 similar to or greater than storage under H4 (Table 11-4-45).

1 Differences in the percent of months exceeding the 56°F threshold in the Feather River at Gridley  
2 between NAA and H4 would generally be negligible (<5% on an absolute scale) during January  
3 through March (Table 11-4-69). The percent of months exceeding the threshold under H4 would be  
4 similar to or up to 25% lower (absolute scale) than the percent under NAA. This represents a small  
5 benefit of H4 to steelhead spawning habitat conditions in the Feather River.

6 Total degree-months above the 56°F threshold in the Feather River at Gridley under H4 would be  
7 similar to those under NAA during October through February (Table 11-4-70). During March and  
8 April, degree-months under H4 would be 5% to 19% lower under H4, representing a small benefit of  
9 H4 to steelhead spawning habitat conditions in the Feather River.

10 Due to similar or better flows, reservoir storage, and water temperatures between H4 and H3,  
11 results for H4 would be similar to or better than those for H3.

### 12 **American River**

13 Flows in the American River at the confluence with the Sacramento River during January through  
14 April under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
15 *Results utilized in the Fish Analysis*).

16 Differences in the percent of months exceeding the 56°F threshold between NAA and H4 would  
17 generally be negligible (<5% on an absolute scale) during January through March (Table 11-4-82).  
18 During April, the percent of months exceeding the threshold under H4 would be similar to or up to  
19 17% lower (absolute scale) than the percent under NAA. This represents a small benefit of H4 to  
20 steelhead spawning habitat conditions in the Feather River.

21 Total degree-months above the 56°F threshold under H4 would be similar to (<3 degree months)  
22 those under NAA during January through March (Table 11-4-83). During April, degree-months  
23 under H4 would be 11 degree-months (12%) lower than under NAA, representing a small benefit of  
24 H4 to steelhead spawning habitat conditions in the Feather River.

25 Due to similar or better flows and water temperatures between H4 and H3, results for H1 would be  
26 similar to or better than those for H3.

27 **NEPA Effects:** Collectively, these results indicate that the effects of Alternative 4 on flow would not  
28 be adverse because they would not substantially reduce suitable spawning habitat or substantially  
29 reduce the number of fish as a result of egg development. There would be negligible effects on mean  
30 monthly flows water temperatures, and reservoir storage, for the applicable locations analyzed.  
31 There would be beneficial effects from increases in mean monthly flow (to 44%) for some months  
32 and water year types during the spawning period in the Feather River below Thermalito Afterbay,  
33 and a beneficial effect from a moderate increase (18%) in cold water pool availability in Oroville  
34 Reservoir which would help offset increased water temperatures in the Feather River attributable to  
35 the project (10%) Further, the SacEFT model predicts that there would be no effects to spawning  
36 and egg incubation habitat in the Sacramento River.

37 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, spawning and  
38 egg incubation habitat for steelhead would not be affected relative to the CEQA baseline.

1 **H3/ESO**

2 ***Sacramento River***

3 The primary steelhead spawning and egg incubation period extends from January through April.  
4 Results of the CALSIM analyses of instream flows within the reach where the majority of steelhead  
5 spawning occurs (Keswick Dam to upstream of RBDD) were summarized by month and water-year  
6 type based on estimated flows at RBDD (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
7 *Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation and  
8 rapid reductions in flow can dewater redds leading to mortality. Comparisons of Alternative 4 to  
9 Existing Conditions, indicate primarily negligible effects (<5%) on mean monthly flow during  
10 January through April, with the exception of small increases in flow (to 15%) in wet and critical  
11 water years, and a single, small decrease (-10%) during March in below normal years that would not  
12 have biologically meaningful negative effects. The small to moderate increases in flow would have a  
13 beneficial effect on spawning conditions, particularly in critical water years (January and March).

14 SacEFT predicts no changes (0% difference) or negligible effect (<5% difference) in spawning  
15 habitat, egg incubation, redd dewatering risk, and redd scour risk for Alternative 4 compared to  
16 Existing Conditions (Table 11-4-78).

17 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
18 examined during the January through April primary steelhead spawning and egg incubation period  
19 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
20 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
21 temperature between Existing Conditions and H3 in any month or water year type throughout the  
22 period at either location.

23 Overall in the Sacramento River, effects of H3 on flow would consist of negligible effects (<5%) or  
24 small increases (to 15%) in mean monthly flow throughout the January to April spawning period,  
25 and negligible effects (<5%) on spawning metrics calculated with SacEFT, and negligible effects on  
26 water temperature.

27 ***Clear Creek***

28 Results of the CALSIM analyses of instream flows for Clear Creek were summarized by month and  
29 water-year type for January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
30 *Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation and  
31 rapid reductions in flow can dewater redds leading to mortality. Comparisons of H3 to Existing  
32 Conditions, indicate no meaningful reductions (>5%) in mean monthly flow for any month or water  
33 type year. There would be primarily negligible effects (<5%), with small to substantial increases in  
34 mean monthly flow in wet years for January through March, ranging from 17% to 54%, and small  
35 increases in critical years for January through April (8% to 10%). Increases in flow would have a  
36 beneficial effect on spawning conditions. These results indicate that effects of flow under H3 would  
37 not have negative effects on steelhead spawning conditions in Clear Creek.

38 In terms of redd dewatering risk, comparison of greatest monthly flow reduction (Table 11-4-79)  
39 indicates no project-related effects (all values 0%) with the exception of an increase in the greatest  
40 monthly flow reduction in wet years (-38%) for H3 relative to Existing Conditions. Based on the fact  
41 that this flow reduction is in wet years, it would not have biologically meaningful negative effects on  
42 steelhead redd dewatering risk.

1 No water temperature modeling was conducted in Clear Creek.

2 The effects of H3 on mean monthly Clear Creek flows would consist of negligible effects and  
3 beneficial increases in flow (to 54%) with no reductions in flow for any month or water year type  
4 throughout the spawning period, and a moderate increase in flow reductions during wet years (-  
5 38%), when effects of flow reductions would be less critical for redd dewatering. Overall, H3 would  
6 not cause biologically meaningful effects on steelhead spawning conditions.

### 7 **Feather River**

8 Results of the CALSIM analyses of instream flows for the Feather River below Thermalito Afterbay  
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January through April  
10 indicate variable effects depending on the specific month and water year type, with primarily  
11 decreases in mean monthly flows during January and February (-6% to -46%) for all but wet water  
12 years (negligible effects during January and an increase of 31% during February). Effects of H3  
13 during March and April would consist primarily of increases in flow ranging from 12% to 58% with  
14 the exception of a substantial decrease (-58%) during March in below normal years and negligible  
15 effects (<5%) during March in drier water year types and during April in wetter water year types.  
16 The most substantial decreases in flow would occur in below normal years for January through  
17 March and would be somewhat offset by a substantial increase during April, although this would  
18 occur late in the spawning period. In general, for the remaining water year types, decreases in flow  
19 during January and February would be somewhat offset by increases during March and April and  
20 net effects would not have biologically meaningful negative effects on spawning conditions.

21 Comparisons for the low-flow channel indicate there would be no changes in conditions for H3  
22 relative to Existing Conditions. Flows are predicted to range from 700 to 800 cfs under all conditions  
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, H3 is not expected to  
24 affect physical habitat conditions for steelhead spawning and egg incubation within the Feather  
25 River low-flow channel.

26 Water temperatures in the low-flow channel of the Feather River are determined largely by  
27 coldwater pool storage in Oroville Reservoir and instream flow releases. Because instream flows in  
28 the low-flow channel would be the same under H3 and Existing Conditions, any simulated changes  
29 in water temperatures under H3 would be attributed to changes in reservoir storage. Reservoir  
30 storage in May and September provides an indicator of coldwater pool availability. Results of  
31 CALSIM modeling of Oroville Reservoir storage in May are shown in Table 11-4-45, and results for  
32 September are shown in Table 11-4-39.

33 Comparison of results indicates that May storage in Oroville Reservoir for H3 would be reduced  
34 relative to Existing Conditions for all water year types, with negligible ( $\leq 5\%$ ) effects in wet and  
35 above normal years and small (-11%) to moderate (-20%) reductions for the remaining water years  
36 (Table 11-4-45). Results for September storage indicate that effects on storage from H3 would  
37 consist of substantial (to -35%) decreases in storage for wetter water years and small (-10%) to  
38 moderate (-28%) reductions for the drier water year types (Table 11-4-39). The reductions in  
39 storage would reduce cold water pool availability and would contribute to negative effects on water  
40 temperature in the Feather River.

41 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito  
42 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January  
43 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*

1 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the  
2 low-flow channel, mean monthly water temperatures under H3 would be 5% to 7% greater than  
3 those under Existing Conditions during January through March and similar to temperatures under  
4 Existing Conditions during April. In the high-flow channel, mean monthly water temperatures under  
5 H3 would be 6% greater than those under Existing Conditions during January and February and  
6 similar to temperatures under Existing Conditions during March and April.

7 Effects of H3 on water temperature-related spawning and egg incubation conditions for steelhead in  
8 the Feather River were analyzed by comparing the percent of months between January through  
9 April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold in the  
10 low-flow channel (above Thermalito Afterbay) (Table 11-4-80). Differences in the percent of months  
11 exceeding the threshold between Existing Conditions and H3 would be negligible (<5% on an  
12 absolute scale) during January and February and for most degrees above the threshold evaluated for  
13 March, except for the >1.0 degree category. During April, the percent of months exceeding the  
14 threshold under H3 would be similar to or up to 44% (absolute scale) higher than the percent under  
15 Existing Conditions.

16 The effects of H3 on water temperature-related spawning and egg incubation conditions for  
17 steelhead in the Feather River were also analyzed by comparing the total degree-months for months  
18 that exceed the 56°F NMFS threshold during the January through April steelhead spawning period for  
19 all 82 years (Table 11-4-81). There would be no difference (<5% on a relative scale) in total degree-  
20 months exceeded between Existing Conditions and H3 during January, February, and in all water  
21 years types except critical during March, in which there would be 8 more degree-months (800%  
22 increase) under H1 relative to Existing Conditions. An increase of 8 degree-months, although  
23 relatively large, is not expected to cause a biologically meaningful effect to steelhead. During April,  
24 the total number of degree months would be 4 to 24 degree-months (up to 600%) higher under H1  
25 compared to Existing Conditions.

26 Overall, the effects of H3 on flows in the Feather River above Thermalito Afterbay would include  
27 substantial decreases in mean monthly flow (to -46%) during some months and water year types  
28 that would be partially offset by increases in other months and/or water year types, with the  
29 exception of more persistent, substantial reductions in flow in below normal years. There would be  
30 substantial increases in the exceedance of water temperature thresholds in the low-flow channel  
31 during April, coupled with a reduction in coldwater pool availability in the Oroville Reservoir (to -  
32 35% depending on month and water year type), that would affect steelhead egg survival.

### 33 **American River**

34 Results of the CALSIM analyses of instream flows within the lower American River at the confluence  
35 with the Sacramento River were summarized by month and water-year type (Appendix 11C, *CALSIM*  
36 *II Model Results utilized in the Fish Analysis*) for January through April. Lower flows can reduce the  
37 instream area available for spawning and egg incubation and rapid reductions in flow can dewater  
38 redds leading to mortality. Comparisons indicate there would be primarily increases in mean  
39 monthly flows (to 27%) for H3 compared to Existing Conditions in wetter water years for January  
40 through March, and decreases (to -19%) in drier water years when flow changes would have more  
41 substantial effects on spawning conditions. Effects during April consist of negligible effects or small  
42 increases or decreases that would occur toward the end of the spawning period and would not have  
43 biologically meaningful effects. Flow decreases in drier water years would be most substantial in  
44 January, at the start of the spawning period, and would be partially offset by small increases in

1 February and March, with the exception of critical water years when flow reductions would persist.  
2 These results indicate that the effects of H3 on flows in the American River at the confluence during  
3 the steelhead spawning and egg incubation period would include moderate reductions in mean  
4 monthly flow (to -19%) that would have biologically meaningful effects on spawning conditions in  
5 drier water years, particularly in critical years. Mean monthly water temperatures in the American  
6 River at the Watt Avenue Bridge were evaluated during the January through April steelhead  
7 spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and*  
8 *Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
9 temperature under H3 would be 5% to 7% lower than those under Existing Conditions during  
10 January through March, and temperatures would not differ between H3 and Existing Conditions  
11 during April.

12 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
13 Avenue Bridge was evaluated during November through April (Table 11-4-64). Steelhead spawn and  
14 eggs incubate in the American River between January and April. During January and February, the  
15 percent of month exceeding the threshold under Existing Conditions and H3 would be similar.  
16 During March and April, the percent of months exceeding the threshold under H3 would be up to  
17 38% greater (absolute scale) than the percent under Existing Conditions.

18 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
19 Avenue Bridge during November through April (Table 11-4-65). During the January and February,  
20 there would be no difference in total degree-months above the threshold between Existing  
21 Conditions and H3. During March and April, total degree-months under H3 would be 395% and 98%  
22 greater than those under Existing Conditions, respectively.

23 Overall in the American River, effects of flow reductions in drier water years, particularly critical  
24 years, would contribute incremental negative effects to regional steelhead spawning conditions.

### 25 ***Stanislaus River***

26 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
27 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
28 *Model Results utilized in the Fish Analysis*). Flows under H3 throughout this period would be up to  
29 36% lower flows under Existing Conditions in all months with few exceptions.

30 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was  
31 evaluated during the January through April steelhead spawning and egg incubation period  
32 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
33 *utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 6% higher than  
34 those under Existing Conditions in all months.

### 35 ***San Joaquin River***

36 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

### 37 ***Mokelumne River***

38 Flows in the Mokelumne River at the Delta were examined during the January through April  
39 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
40 *Fish Analysis*). Flows under H3 would generally be similar to flows under Existing Conditions during  
41 March, up to 18% greater during February, and up to 14% lower during April.

1 Water temperature modeling was not conducted in the Mokelumne River.

## 2 **H1/LOS**

### 3 ***Sacramento River***

4 Flows in the Sacramento River at Keswick and upstream of Red Bluff during January through April  
5 under H1 would generally be similar to or greater than flows under H3 (Appendix 11C, *CALSIM II*  
6 *Model Results utilized in the Fish Analysis*).

7 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
8 examined during the January through April primary steelhead spawning and egg incubation period  
9 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
10 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
11 temperature between Existing Conditions and H1 in any month or water year type throughout the  
12 period at either location, except for critical years during January at Red Bluff (5% higher).

13 Due to similar flows and water temperatures between H1 and H3, results for additional analyses  
14 (e.g., SacEFT) under H1 would be similar to results for analyses under H3. As a result, these  
15 additional analyses were not conducted for H1. Overall, results for H1 would be similar to or better  
16 than those for H3.

### 17 ***Clear Creek***

18 Flows in the Clear Creek during January through April under H1 would generally be similar to flows  
19 under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water  
20 temperature modeling was conducted in Clear Creek. Due to similar flows between H1 and H3,  
21 results for additional analyses (e.g., redds dewatering risk,) under H1 would be similar to results for  
22 analyses under H3. As a result, these additional analyses were not conducted for H1. Overall, results  
23 for H1 would be similar to those for H3.

### 24 ***Feather River***

25 Flows in the Feather River above Thermalito Afterbay (low-flow channel) during January through  
26 April under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
27 *Results utilized in the Fish Analysis*). Flows in the Feather River below Thermalito Afterbay (high-  
28 flow channel) during January through April under H1 would generally be similar to or greater than  
29 flows under H3. May and September Oroville storage under H1 would generally be similar to or  
30 greater than storage under H3 (Table 11-4-39, Table 11-4-45).

31 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito  
32 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January  
33 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*  
34 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the  
35 low-flow channel, mean monthly water temperatures under H1 would be 5% to 7% greater than  
36 those under Existing Conditions during January through March and similar to temperatures under  
37 Existing Conditions during April. In the high-flow channel, mean monthly water temperatures under  
38 H1 would be 6% greater than those under Existing Conditions during January and February and  
39 similar to temperatures under Existing Conditions during March and April.

1 Differences in the percent of months exceeding the 56°F threshold between Existing Conditions and  
2 H1 would generally be negligible (<5% on an absolute scale) during January through March (Table  
3 11-4-82). During April, the percent of months exceeding the threshold under H1 would be similar to  
4 or up to 32% higher (absolute scale) than the percent under Existing Conditions. This represents a  
5 small negative effect of H1 to steelhead spawning habitat conditions in the Feather River.

6 Total degree-months above the 56°F threshold under H1 would be similar to those under Existing  
7 Conditions during January, February, and all water year types except critical water years in March,  
8 in which there would be 6 more degree-months (600% increase) under H1 relative to Existing  
9 Conditions (Table 11-4-83). An increase of 6 degree-months, although relatively large, is not  
10 expected to cause a biologically meaningful effect to steelhead. During April, the total number of  
11 degree months would be 4 to 24 degree-months (up to 600%) higher under H1 compared to  
12 Existing Conditions.

13 Due to similar or better flows, reservoir storage, and water temperatures between H1 and H3,  
14 results for H1 would be similar to or better than those for H3.

### 15 **American River**

16 Flows in the American River at the confluence with the Sacramento River during January through  
17 April under H1 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
18 *Results utilized in the Fish Analysis*).

19 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
20 during the January through April steelhead spawning and egg incubation period (Appendix 11D,  
21 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
22 *Fish Analysis*). Mean monthly water temperature under H1 would be 5% to 7% lower than those  
23 under Existing Conditions during January through March, and temperatures would not differ  
24 between H1 and Existing Conditions during April.

25 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
26 Avenue Bridge was evaluated during November through April (Table 11-4-71). Steelhead spawn and  
27 eggs incubate in the American River between January and April. During January and February, the  
28 percent of month exceeding the threshold under Existing Conditions and H1 would be similar.  
29 During March and April, the percent of months exceeding the threshold under H1 would be up to  
30 11% greater (absolute scale) than the percent under Existing Conditions.

31 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
32 Avenue Bridge during November through April (Table 11-4-72). During the January and February,  
33 there would be no difference in total degree-months above the threshold between Existing  
34 Conditions and H1. During March and April, total degree-months under H1 would be 384% and 95%  
35 greater than those under Existing Conditions, respectively.

36 Due to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
37 those for H3.

### 38 **Stanislaus River**

39 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
40 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*

1 *Model Results utilized in the Fish Analysis*). Flows under H1 throughout this period would be up to  
2 36% lower flows under Existing Conditions in all months with few exceptions.

3 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was  
4 evaluated during the January through April steelhead spawning and egg incubation period  
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
6 *utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 6% higher than  
7 those under Existing Conditions in all months.

#### 8 ***San Joaquin River***

9 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 10 ***Mokelumne River***

11 Flows in the Mokelumne River at the Delta were examined during the January through April  
12 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
13 *Fish Analysis*). Flows under H1 would generally be similar to flows under Existing Conditions during  
14 March, up to 18% greater during February, and up to 14% lower during April.

15 Water temperature modeling was not conducted in the Mokelumne River.

#### 16 **H4/HOS**

#### 17 ***Sacramento River***

18 Flows in the Sacramento River at Keswick and upstream of Red Bluff during January through April  
19 under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results*  
20 *utilized in the Fish Analysis*).

21 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were  
22 examined during the January through April primary steelhead spawning and egg incubation period  
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
24 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
25 temperature between Existing Conditions and H1 in any month or water year type throughout the  
26 period at either location, except for critical years during January at Red Bluff (5% higher).

27 Due to similar flows and water temperatures between H4 and H3, results for additional analyses  
28 (e.g., SacEFT) under H4 would be similar to results for analyses under H3. As a result, these  
29 additional analyses were not conducted for H4. Overall, results for H4 would be similar to those for  
30 H3.

#### 31 ***Clear Creek***

32 Flows in the Clear Creek during January through April under H4 would generally be similar to flows  
33 under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water  
34 temperature modeling was conducted in Clear Creek. Due to similar flows between H4 and H3,  
35 results for additional analyses (e.g., redd dewatering risk) under H4 would be similar to results for  
36 analyses under H3. As a result, these additional analyses were not conducted for H4. Overall, results  
37 for H4 would be similar to those for H3.

1 **Feather River**

2 Flows in the Feather River above Thermalito Afterbay (low-flow channel) during January through  
3 April under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
4 *Results utilized in the Fish Analysis*). Flows in the Feather River below Thermalito Afterbay (high-  
5 flow channel) during January through April under H4 would generally be similar to or greater than  
6 flows under H3.

7 May storage would be 11% to 15% lower under H4 relative to H3 in wet, above normal, and below  
8 normal water years (Table 11-4-45). Regardless, there would be no differences in water  
9 temperatures between H4 and H3 scenarios during any month or water year type. September  
10 Oroville storage under H4 would generally be similar to or greater than storage under H4 (Table 11-  
11 4-39).

12 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito  
13 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January  
14 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*  
15 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the  
16 low-flow channel, mean monthly water temperatures under H4 would be 5% to 7% greater than  
17 those under Existing Conditions during January through March and similar to temperatures under  
18 Existing Conditions during April. In the high-flow channel, mean monthly water temperatures under  
19 H4 would be 6% greater than those under Existing Conditions during January and February and  
20 similar to temperatures under Existing Conditions during March and April.

21 Differences in the percent of months exceeding the 56°F threshold between Existing Conditions and  
22 H4 would generally be negligible (<5% on an absolute scale) during January through March except  
23 for the >1.0 degree category for March (5% higher) (Table 11-4-82). During April, the percent of  
24 months exceeding the threshold under H4 would be similar to or up to 27% higher (absolute scale)  
25 than the percent under Existing Conditions. This represents a small negative effect of H4 to  
26 steelhead spawning habitat conditions in the Feather River.

27 Total degree-months above the 56°F threshold under H4 would be similar to those under Existing  
28 Conditions during January, February, and all water year types except critical water years in March,  
29 in which there would be 7 more degree-months (700% increase) under H1 relative to Existing  
30 Conditions (Table 11-4-83). An increase of 7 degree-months, although relatively large, is not  
31 expected to cause a biologically meaningful effect to steelhead. During April, the total number of  
32 degree months would be 3 to 25 degree-months (up to 500%) higher under H1 compared to  
33 Existing Conditions.

34 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for H4  
35 would be similar to or better than those for H3.

36 **American River**

37 Flows in the American River at the confluence with the Sacramento River during January through  
38 April under H4 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
39 *Results utilized in the Fish Analysis*).

40 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated  
41 during the January through April steelhead spawning and egg incubation period (Appendix 11D,  
42 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). Mean monthly water temperature under H4 would be 5% to 7% lower than those  
2 under Existing Conditions during January through March, and temperatures would not differ  
3 between H4 and Existing Conditions during April.

4 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt  
5 Avenue Bridge was evaluated during November through April (Table 11-4-71). Steelhead spawn and  
6 eggs incubate in the American River between January and April. During January and February, the  
7 percent of month exceeding the threshold under Existing Conditions and H4 would be similar.  
8 During March and April, the percent of months exceeding the threshold under H4 would be up to  
9 30% greater (absolute scale) than the percent under Existing Conditions.

10 Total degree-months exceeding 56°F were summed by month and water year type at the Watt  
11 Avenue Bridge during November through April (Table 11-4-72). During the January and February,  
12 there would be no difference in total degree-months above the threshold between Existing  
13 Conditions and H4. During March and April, total degree-months under H4 would be 395% and 95%  
14 greater than those under Existing Conditions, respectively.

15 Due to similar flows and water temperatures between H4 and H3, results for H4 would be similar to  
16 those for H3.

#### 17 ***Stanislaus River***

18 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the  
19 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*  
20 *Model Results utilized in the Fish Analysis*). Flows under H4 throughout this period would be up to  
21 36% lower flows under Existing Conditions in all months with few exceptions.

22 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was  
23 evaluated during the January through April steelhead spawning and egg incubation period  
24 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
25 *utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 6% higher than  
26 those under Existing Conditions in all months.

#### 27 ***San Joaquin River***

28 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

#### 29 ***Mokelumne River***

30 Flows in the Mokelumne River at the Delta were examined during the January through April  
31 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*  
32 *Fish Analysis*). Flows under H4 would generally be similar to flows under Existing Conditions during  
33 March, up to 18% greater during February, and up to 14% lower during April.

34 Water temperature modeling was not conducted in the Mokelumne River.

#### 35 **Summary of CEQA Conclusion**

36 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between  
37 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
38 alternative could substantially reduce suitable spawning habitat and substantially reduce the  
39 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above.

1 Alternative 4 would reduce steelhead spawning conditions through reduced mean monthly flows (to  
2 -58%), substantial increases in exposure to critical water temperatures, and substantial reductions  
3 in cold water pool availability that would also affect water temperatures in the Feather River, and  
4 through moderate reductions in mean monthly flows in the American River, particularly during  
5 drier water years. These effects would degrade spawning conditions and increase egg mortality.  
6 Alternative 4 would not have significant effects on steelhead spawning conditions in the Sacramento  
7 River and Clear Creek. Results would generally be similar among scenarios.

8 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
9 change, future water demands, and implementation of the alternative. The analysis described above  
10 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
11 alternative from those of sea level rise, climate change and future water demands using the model  
12 simulation results presented in this chapter. However, the increment of change attributable to the  
13 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
14 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
15 implementation period, which does include future sea level rise, climate change, and water  
16 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
17 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
18 effect of the alternative from those of sea level rise, climate change, and water demands.

19 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
20 term implementation period and H3 indicates that flows in the locations and during the months  
21 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
22 indicates that the differences between Existing Conditions and Alternative 4 found above would  
23 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
24 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
25 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
26 impact on migration conditions for steelhead. This impact is found to be less than significant and no  
27 mitigation is required.

### 28 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

29 In general, the effects of Alternative 4 on steelhead rearing conditions would be negligible relative to  
30 the NAA

### 31 **H3/ESO**

#### 32 ***Sacramento River***

33 Juvenile steelhead rear within the Sacramento River and its tributaries throughout the year because  
34 juveniles inhabit upstream areas for a period of 1 to 2 years before migrating downstream to the  
35 ocean. Results of the CALSIM analyses of instream flows within the reach where the majority of  
36 steelhead spawning occurs (Keswick Dam to upstream of Red Bluff) (Appendix 11C, *CALSIM II Model*  
37 *Results utilized in the Fish Analysis*) were evaluated for effects of H3. Lower flows can reduce the  
38 instream area available for rearing and rapid reductions in flow can strand fry and juveniles, leading  
39 to mortality.

40 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
41 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
42 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There

1 would be no differences (<5%) in mean monthly water temperature between NAA and H3 in any  
2 month or water year type throughout the period at either location.

3 In general, effects of H3 on mean monthly flow would consist of primarily negligible increases in  
4 flow (to 20%) relative to NAA throughout the year, with the exception of isolated, small reductions  
5 in flow and more persistent flow reductions in all water year types during November (to -23%).

6 SacEFT predicts that there would be a 22% reduction in years classified as good juvenile rearing  
7 habitat conditions under H3 compared to NAA, but there would be a 10% increase in the percentage  
8 of years classified “good” with respect to juvenile stranding risk (Table 11-4-78). The decrease in the  
9 percentage of years when juvenile rearing habitat is classified as good for H3 would contribute to an  
10 incremental reduction in good habitat conditions and an increase in the risk of mortality to juvenile  
11 steelhead resulting from stranding.

12 Based on mean monthly flows, SacEFT rearing metrics, and water temperature effects, project-  
13 related effects under Alternative 4 in the Sacramento River would not have biologically meaningful  
14 negative effects on steelhead rearing conditions. Effects of H3 consist primarily of negligible effects  
15 that would not have biologically meaningful effects on rearing success with the exception of a  
16 moderate decrease (-22%) in rearing habitat conditions based on SacEFT, that would be partially  
17 offset by a small beneficial effect on stranding risk (10%).

18 **Clear Creek**

19 Steelhead rear in Clear Creek throughout the year. Lower flows can reduce the instream area  
20 available for rearing and rapid reductions in flow can strand fry and juveniles leading to mortality.  
21 Instream flows estimated from the modeling each month and water-year type were used to compare  
22 among model scenarios (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In  
23 general, flows under H3 would generally be similar to those under NAA with few exceptions.

24 Evaluation of the minimum instream flows in Clear Creek indicates that H3 would have no effect  
25 (0%) on minimum instream flows in any water year type (Table 11-4-84).

26 **Table 11-4-84. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during**  
27 **the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-50 (-100%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	-50 (-100%)	0 (0%)
Critical	-50 (-100%)	0 (NA)

Note: Minimum flows occurred between October and March.  
NA = could not be calculated because the denominator was 0.

28  
29 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-  
30 1A-4). The current Clear Creek management regime uses flows slightly lower than those  
31 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being  
32 analyzed. Depending on results of this study the flow regime could be adjusted in the future. It is

1 expected that the modeled flows will be suitable for the existing steelhead populations in Clear  
2 Creek. No change in effect on steelhead in Clear Creek is anticipated.

3 No water temperature modeling was conducted in Clear Creek.

4 These results indicate that effects of H3 on flows would not affect juvenile steelhead rearing habitats  
5 in Clear Creek.

### 6 **Feather River**

7 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and  
8 rearing. Although there is relatively little natural steelhead production in the river, most steelhead  
9 spawning and rearing appears to occur in the low-flow channel in habitats associated with well-  
10 vegetated side channels (Cavallo et al. 2003; California Department of Water Resources unpublished  
11 data). Because these habitats are relatively uncommon they could limit natural steelhead  
12 production. Lower flows can reduce the instream area available for rearing and rapid reductions in  
13 flow can strand fry and juveniles leading to mortality.

14 There would be no change in flows for H3 relative to NAA in the low-flow channel. Flow in the low-  
15 flow channel is projected to remain between 700 and 800 cfs except during occasional flood control  
16 releases. This flow is less than pre-dam levels during all months of the year as a result of water  
17 diversions through the Thermalito Afterbay. The significance of these flow conditions for steelhead  
18 spawning and rearing is uncertain. Feather River screw trap data indicate that Chinook salmon  
19 initiate emigration regardless of flow regime (i.e., they do not wait for a high-flow pulse). This is  
20 likely true for steelhead as well.

21 The river channel downstream of Thermalito (high-flow channel) offers few of the habitat types  
22 upon which steelhead appear to rely in the low-flow channel. Experiments and fish observations  
23 also indicate that predation risk for juvenile steelhead is higher downstream of the Thermalito  
24 outlet (California Department of Water Resources 2004). Increased predation risk is likely a  
25 function of water temperature, where warm water nonnative species such as striped bass,  
26 largemouth bass, and smallmouth bass are more prevalent, and in general, predators have greater  
27 metabolic requirements. Thus, summer temperatures that exceed 65°F and the absence of preferred  
28 steelhead habitat currently appear to limit steelhead rearing in the river downstream of the  
29 Thermalito outlet. Comparisons of CALSIM data by month and water year type (Appendix 11C,  
30 *CALSIM II Model Results utilized in the Fish Analysis*) indicate that flows under H3 would generally be  
31 greater than or similar to those under NAA in the high-flow channel in all months except July  
32 through September. During July through September, flows under H3 would be up to 50% lower than  
33 those under NAA depending on month, water-year type and comparison.

34 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
35 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
36 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature  
37 Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
38 water temperature between NAA and H3 in any month or water year type throughout the period at  
39 either location.

40 Effects of H3 on water temperature-related juvenile rearing conditions for steelhead in the Feather  
41 River were analyzed by comparing the percent of months between May through August over the 82-  
42 year CALSIM modeling period that exceed a 63°F temperature threshold in the low-flow channel  
43 (above Thermalito Afterbay) and by comparing the percent of months between October and April

1 that exceed a 56°F threshold at Gridley. Results for the low-flow channel (above Thermalito  
2 Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and egg  
3 incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low-flow channel and at Gridley,  
4 there would generally be no differences between NAA and H3 on the percent of months exceeding  
5 the threshold.

6 The effects of H3 on water temperature-related juvenile rearing conditions for spring-run Chinook  
7 salmon in the Feather River were also analyzed by comparing the total degree-months for months  
8 that exceed the 63°F NMFS threshold during May through August in the low-flow channel and the  
9 56°F threshold during October through April at Gridley. Results for the low-flow channel (above  
10 Thermalito Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and  
11 egg incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low flow channel and at  
12 Gridley, there would be small increases and decreases in exceedances above the thresholds, but  
13 overall no biologically meaningful effects.

#### 14 ***American River***

15 Flows in the American River at the confluence with the Sacramento River were examined for the  
16 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
17 *Analysis*). Flows under H3 would generally be greater than or similar to flows under NAA in all  
18 months except August and September. Flows during August and September would be up to 28%  
19 lower under H3 than under NAA. Because these reductions would occur only during these months  
20 and would be generally low to moderate, they are not expected to cause biologically meaningful  
21 effects on steelhead juvenile rearing habitat.

22 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
23 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
24 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
25 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
26 temperature between NAA and H3 in any month or water year type throughout the period.

27 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
28 Avenue Bridge was evaluated during May through October (Table 11-4-85). During May, June, and  
29 October, the percent of months exceeding the threshold under H3 would similar to or up to 14%  
30 lower (absolute scale) than the percent under NAA. During July through September, the percent of  
31 months exceeding the threshold would mostly be similar between NAA and H3 with one or two  
32 degree categories in which there would be increases of up to 7% on an absolute scale in percent of  
33 months exceeding the threshold under H3.

1 **Table 11-4-85. Differences between Baseline and H3 Scenarios in Percent of Months during the**  
 2 **82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the**  
 3 **Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
May	41 (206%)	33 (225%)	23 (211%)	21 (340%)	10 (200%)
June	35 (54%)	35 (65%)	32 (79%)	21 (68%)	17 (82%)
July	0 (0%)	1 (1%)	36 (57%)	42 (117%)	42 (243%)
August	0 (0%)	2 (3%)	19 (23%)	51 (105%)	67 (216%)
September	15 (17%)	46 (86%)	58 (181%)	63 (392%)	53 (717%)
October	75 (1,525%)	63 (2,550%)	42 (NA)	27 (NA)	12 (NA)
<b>NAA vs. H3</b>					
May	-4 (-6%)	-1 (-3%)	-5 (-13%)	-5 (-15%)	-2 (-14%)
June	0 (0%)	-4 (-4%)	-9 (-11%)	-14 (-21%)	-10 (-21%)
July	0 (0%)	0 (0%)	1 (1%)	6 (9%)	4 (7%)
August	0 (0%)	0 (0%)	0 (0%)	2 (3%)	7 (8%)
September	0 (0%)	1 (1%)	5 (6%)	5 (7%)	0 (0%)
October	0 (0%)	0 (0%)	-4 (-8%)	-2 (-8%)	1 (11%)
NA = could not be calculated because the denominator was 0.					

4

5 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
 6 Avenue Bridge during May through October (Table 11-4-86). Total degree-months exceeding the  
 7 threshold would be similar between NAA and H3 or up to 12% lower under H3 in all months except  
 8 July, in which degree-months would be 8% higher under H3.

1 **Table 11-4-86. Differences between Baseline and H3 Scenarios in Total Degree-Months**  
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in**  
 3 **the American River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
May	Wet	20 (333%)	-1 (-4%)
	Above Normal	24 (NA)	-3 (-11%)
	Below Normal	18 (600%)	-5 (-19%)
	Dry	24 (109%)	-10 (-18%)
	Critical	34 (179%)	2 (4%)
	All	120 (240%)	-17 (-9%)
June	Wet	47 (276%)	-21 (-25%)
	Above Normal	21 (88%)	-11 (-20%)
	Below Normal	28 (97%)	-10 (-15%)
	Dry	35 (51%)	-5 (-5%)
	Critical	47 (94%)	-3 (-3%)
	All	178 (95%)	-50 (-12%)
July	Wet	54 (69%)	5 (4%)
	Above Normal	10 (37%)	4 (12%)
	Below Normal	26 (76%)	5 (9%)
	Dry	71 (115%)	20 (18%)
	Critical	48 (59%)	2 (2%)
	All	209 (74%)	36 (8%)
August	Wet	106 (134%)	-2 (-1%)
	Above Normal	32 (78%)	-1 (-1%)
	Below Normal	54 (96%)	17 (18%)
	Dry	91 (134%)	10 (7%)
	Critical	69 (87%)	5 (3%)
	All	352 (109%)	29 (4%)
September	Wet	83 (346%)	9 (9%)
	Above Normal	46 (288%)	10 (19%)
	Below Normal	49 (175%)	2 (3%)
	Dry	81 (193%)	-5 (-4%)
	Critical	55 (112%)	2 (2%)
	All	314 (197%)	18 (4%)
October	Wet	48 (4,800%)	-6 (-11%)
	Above Normal	27 (NA)	1 (4%)
	Below Normal	39 (NA)	0 (0%)
	Dry	37 (NA)	0 (0%)
	Critical	31 (620%)	1 (3%)
	All	182 (3,033%)	-4 (-2%)

NA = could not be calculated because the denominator was 0.

4  
 5 These results indicate that effects of H3 on flow and water temperatures would not reduce juvenile  
 6 rearing conditions in the American River.

1       **Stanislaus River**

2       Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
3       year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4       *Analysis*). Flows under H3 would be similar to flows under NAA throughout the period.

5       Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and  
6       H3 throughout the year-round period (Appendix 11D, *Sacramento River Water Quality Model and*  
7       *Reclamation Temperature Model Results utilized in the Fish Analysis*).

8       **San Joaquin River**

9       Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
10       period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would  
11       be similar to flows under NAA throughout the period.

12       Water temperature modeling was not conducted in the San Joaquin River.

13       **Mokelumne River**

14       Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
15       period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would  
16       be similar to flows under NAA throughout the period.

17       Water temperature modeling was not conducted in the Mokelumne River.

18       **H1/LOS**

19       **Sacramento River**

20       Year-round flows in the Sacramento River at Keswick and upstream of Red Bluff under H1 would  
21       generally be similar to flows under H3, except during September and November, during which flows  
22       would be up to 46% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
23       These isolated reductions would not have biologically meaningful effects on steelhead fry and  
24       juvenile rearing habitat.

25       Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
26       examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
27       *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
28       would be no differences (<5%) in mean monthly water temperature between NAA and H1 in any  
29       month or water year type throughout the period at either location.

30       Due to similar flows and water temperatures between H1 and H3, results for additional analyses  
31       (e.g., SacEFT, minimum mean monthly flow comparisons) under H1 would be similar to results for  
32       analyses under H3. As a result, these additional analyses were not conducted for H1. Overall, results  
33       for H1 would be similar to those for H3.

34       **Clear Creek**

35       Year-round flows in the Clear Creek under H1 would generally be similar to flows under H3  
36       (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature  
37       modeling was conducted in Clear Creek. Due to similar flows between H1 and H3, results for  
38       additional analyses (e.g., minimum mean monthly flow comparisons) under H1 would be similar to

1 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
2 Overall, results for H1 would be similar to those for H3.

### 3 **Feather River**

4 Year-round flows in the Feather River above Thermalito Afterbay (low-flow channel) under H1  
5 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
6 *Fish Analysis*). Year-round flows in the Feather River below Thermalito Afterbay (high-flow channel)  
7 under H1 would generally be similar to or greater than flows under H3, except during September  
8 during which flows would be up to 83% lower than flows under NAA. This isolated reduction would  
9 not have biologically meaningful effects on steelhead fry and juvenile rearing habitat.

10 May and September Oroville storage under H1 would generally be similar to or greater than storage  
11 under H3 (Table 11-4-45, Table 11-4-39).

12 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
13 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
14 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*  
15 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
16 water temperature between NAA and H1 in any month or water year type throughout the period at  
17 either location.

18 The analysis evaluating the percent of months exceeding water temperature thresholds from NMFS  
19 presented in Impacts AQUA-59 and AQUA-76 indicates that there would be a small benefit of H1  
20 relative to NAA in the low flow channel and at Gridley.

21 The analysis evaluating the total degree-months exceeding water temperature thresholds from  
22 NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that exceedances under H1 would  
23 generally be similar to or lower than those under NAA in the low flow channel and at Gridley,  
24 representing a small benefit of H1. Due to similar flows, reservoir storage, and water temperatures  
25 between H1 and H3, results for H1 would be similar to or better than those for H3.

### 26 **American River**

27 Year-round flows in the American River at the confluence with the Sacramento River under H1  
28 would generally be similar to flows under H3, except during September, during which flows would  
29 be up to 38% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These isolated  
30 flow reductions would not have biologically meaningful effects on steelhead fry and juvenile habitat  
31 because they only occur during one of 12 months.

32 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
33 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
34 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
35 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
36 temperature between NAA and H1 in any month or water year type throughout the period.

37 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
38 Avenue Bridge was evaluated during May through October (Table 11-4-87). During May, June, and  
39 October, the percent of months exceeding the threshold under H1 would similar to or up to 26%  
40 lower (absolute scale) than the percent under NAA. During July through September, the percent of  
41 months exceeding the threshold would mostly be similar between NAA and H1 with one or two

1 degree categories in which there would be increases of up to 10% on an absolute scale and  
2 decreases of up to 9% on an absolute scale in percent of months exceeding the threshold under H1.

3 **Table 11-4-87. Differences between Baseline Scenarios and H1 and H4 Scenarios in Percent of**  
4 **Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the**  
5 **American River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
May	20 (100%)	16 (108%)	5 (44%)	5 (80%)	1 (25%)
June	19 (29%)	19 (35%)	11 (27%)	9 (28%)	7 (35%)
July	0 (0%)	1 (1%)	9 (14%)	15 (41%)	11 (64%)
August	0 (0%)	2 (3%)	17 (21%)	46 (95%)	46 (148%)
September	14 (16%)	31 (58%)	32 (100%)	28 (177%)	21 (283%)
October	11 (225%)	7 (300%)	5 (NA)	2 (NA)	0 (NA)
<b>NAA vs. H1</b>					
May	-10 (-15%)	-2 (-5%)	-7 (-19%)	-11 (-35%)	-6 (-36%)
June	-1 (-1%)	-5 (-5%)	-26 (-32%)	-26 (-40%)	-21 (-44%)
July	0 (0%)	0 (0%)	-9 (-9%)	-1 (-2%)	-2 (-4%)
August	0 (0%)	0 (0%)	0 (0%)	1 (1%)	4 (4%)
September	0 (0%)	2 (3%)	10 (12%)	6 (8%)	1 (2%)
October	-11 (-14%)	-20 (-30%)	-16 (-35%)	-16 (-54%)	-4 (-33%)
<b>EXISTING CONDITIONS vs. H4</b>					
May	40 (200%)	32 (217%)	21 (189%)	19 (300%)	9 (175%)
June	33 (52%)	37 (70%)	26 (64%)	21 (68%)	22 (106%)
July	0 (0%)	1 (1%)	28 (45%)	33 (93%)	35 (200%)
August	0 (0%)	2 (3%)	17 (21%)	44 (92%)	57 (184%)
September	14 (16%)	42 (79%)	47 (146%)	48 (300%)	43 (583%)
October	72 (1,450%)	41 (1,650%)	36 (NA)	21 (NA)	9 (NA)
<b>NAA vs. H4</b>					
May	-5 (-8%)	-2 (-5%)	-7 (-19%)	-7 (-23%)	-4 (-21%)
June	-1 (-1%)	-1 (-1%)	-15 (-18%)	-14 (-21%)	-5 (-10%)
July	0 (0%)	0 (0%)	-6 (-6%)	-2 (-3%)	-4 (-7%)
August	0 (0%)	0 (0%)	-1 (-1%)	-4 (-4%)	-2 (-3%)
September	-1 (-1%)	-2 (-3%)	-6 (-7%)	-10 (-13%)	-10 (-16%)
October	-4 (-5%)	-22 (-34%)	-10 (-22%)	-9 (-29%)	-2 (-22%)

NA = could not be calculated because the denominator was 0.

6  
7 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
8 Avenue Bridge during May through October (Table 11-4-88). Total degree-months exceeding the  
9 threshold would be similar between NAA and H1 or up to 12% lower under H1 in all months except  
10 July and September, in which degree-months would be 10% and 9%, higher, respectively, under H1.

1  
2  
3

**Table 11-4-88. Differences between Baseline Scenarios and H1 and H4 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in the American River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
May	Wet	21 (350%)	0 (0%)	22 (367%)	1 (4%)
	Above Normal	23 (NA)	-4 (-15%)	25 (NA)	-2 (-7%)
	Below Normal	16 (533%)	-7 (-27%)	24 (800%)	1 (4%)
	Dry	27 (123%)	-7 (-13%)	29 (132%)	-5 (-9%)
	Critical	32 (168%)	0 (0%)	32 (168%)	0 (0%)
	All	120 (240%)	-17 (-9%)	131 (262%)	-6 (-3%)
June	Wet	45 (265%)	-23 (-27%)	63 (371%)	-5 (-6%)
	Above Normal	21 (88%)	-11 (-20%)	34 (142%)	2 (4%)
	Below Normal	13 (45%)	-25 (-37%)	35 (121%)	-3 (-4%)
	Dry	34 (50%)	-6 (-6%)	44 (65%)	4 (4%)
	Critical	39 (78%)	-11 (-11%)	41 (82%)	-9 (-9%)
	All	152 (81%)	-76 (-18%)	218 (116%)	-10 (-2%)
July	Wet	51 (65%)	2 (2%)	51 (65%)	2 (2%)
	Above Normal	11 (41%)	5 (15%)	12 (44%)	6 (18%)
	Below Normal	36 (106%)	15 (27%)	26 (76%)	5 (9%)
	Dry	66 (106%)	15 (13%)	55 (89%)	4 (4%)
	Critical	54 (67%)	8 (6%)	47 (58%)	1 (1%)
	All	218 (77%)	45 (10%)	191 (68%)	18 (4%)
August	Wet	106 (134%)	-2 (-1%)	97 (123%)	-11 (-6%)
	Above Normal	31 (76%)	-2 (-3%)	27 (66%)	-6 (-8%)
	Below Normal	55 (98%)	18 (19%)	40 (71%)	3 (3%)
	Dry	93 (137%)	12 (8%)	83 (122%)	2 (1%)
	Critical	64 (81%)	0 (0%)	66 (84%)	2 (1%)
	All	350 (108%)	27 (4%)	313 (97%)	-10 (-2%)
September	Wet	107 (446%)	33 (34%)	75 (313%)	1 (1%)
	Above Normal	49 (306%)	13 (25%)	37 (231%)	1 (2%)
	Below Normal	48 (171%)	1 (1%)	45 (161%)	-2 (-3%)
	Dry	83 (198%)	-3 (-2%)	80 (190%)	-6 (-5%)
	Critical	52 (106%)	-1 (-1%)	52 (106%)	-1 (-1%)
	All	339 (213%)	43 (9%)	289 (182%)	-7 (-2%)
October	Wet	43 (4,300%)	-11 (-20%)	47 (4,700%)	-7 (-13%)
	Above Normal	26 (NA)	0 (0%)	29 (NA)	3 (12%)
	Below Normal	29 (NA)	-10 (-26%)	38 (NA)	-1 (-3%)
	Dry	32 (NA)	-5 (-14%)	34 (NA)	-3 (-8%)
	Critical	28 (560%)	-2 (-6%)	27 (540%)	-3 (-9%)
	All	157 (2,617%)	-29 (-15%)	175 (2,917%)	-11 (-6%)

NA = could not be calculated because the denominator was 0.

4

1 Due to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
2 those for H3.

3 ***Stanislaus River***

4 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
5 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Flows under H1 would be similar to flows under NAA throughout the period.

7 Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and  
8 H1 throughout the year-round period (Appendix 11D, *Sacramento River Water Quality Model and*  
9 *Reclamation Temperature Model Results utilized in the Fish Analysis*).

10 ***San Joaquin River***

11 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
12 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would  
13 be similar to flows under NAA throughout the period.

14 Water temperature modeling was not conducted in the San Joaquin River.

15 ***Mokelumne River***

16 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
17 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would  
18 be similar to flows under NAA throughout the period.

19 Water temperature modeling was not conducted in the Mokelumne River.

20 **H4/HOS**

21 ***Sacramento River***

22 Year-round flows in the Sacramento River at Keswick and upstream of Red Bluff under H4 would  
23 generally be similar to flows under H3, except during May and June, during which flows would be up  
24 to 13% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These small and  
25 isolated reductions would not have biologically meaningful effects on steelhead fry and juvenile  
26 rearing habitat.

27 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
28 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
29 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
30 would be no differences (<5%) in mean monthly water temperature between NAA and H4 in any  
31 month or water year type throughout the period at either location.

32 Due to similar flows and water temperatures between H4 and H3, results for additional analyses  
33 (e.g., SacEFT, minimum mean monthly flow comparisons) under H4 would be similar to results for  
34 analyses under H3. As a result, these additional analyses were not conducted for H4. Overall, results  
35 for H4 would be similar to those for H3.

1 **Clear Creek**

2 Year-round flows in the Clear Creek under H4 would generally be similar to flows under H3  
3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature  
4 modeling was conducted in Clear Creek. Due to similar flows between H4 and H3, results for  
5 additional analyses (e.g., minimum mean monthly flow comparisons) under H4 would be similar to  
6 results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
7 Overall, results for H4 would be similar to those for H3.

8 **Feather River**

9 Year-round flows in the Feather River above Thermalito Afterbay (low-flow channel) under H4  
10 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
11 *Fish Analysis*). Flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4  
12 during January through May and November through December would generally be similar to or  
13 greater than flows under H3. However, flows during June through October would generally be up to  
14 39% lower under H4.

15 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
16 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
17 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*  
18 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly  
19 water temperature between NAA and H4 in any month or water year type throughout the period at  
20 either location.

21 The analysis evaluating the percent of months exceeding water temperature thresholds from NMFS  
22 presented in Impacts AQUA-59 and AQUA-76 indicates that there would be a small to moderate  
23 benefits of H4 relative to NAA in the low-flow channel and at Gridley.

24 The analysis evaluating the total degree-months exceeding water temperature thresholds from  
25 NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that exceedances under H4 would  
26 generally be similar to or lower than those under NAA in the low flow channel and at Gridley,  
27 representing a small benefit of H4.

28 May storage would be 11% to 15% lower under H4 relative to H3 in wet, above normal, and below  
29 normal water years (Table 11-4-45). September Oroville storage under H4 would generally be  
30 similar to or greater than storage under H4 (Table 11-4-39).

31 Due to similar flows, reservoir storage, and water temperatures between H4 and H3, results for H4  
32 would be similar to or better than those for H3.

33 **American River**

34 Year-round flows in the American River at the confluence with the Sacramento River under H4  
35 would generally be similar to flows under H3, except during June and October, during which flows  
36 would be up to 22% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These  
37 isolated flow reductions would not have biologically meaningful effects on steelhead fry and juvenile  
38 habitat because they only occur during two of 12 months.

39 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
40 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
41 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*

1 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
2 temperature between NAA and H4 in any month or water year type throughout the period.

3 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
4 Avenue Bridge was evaluated during May through October (Table 11-4-87). During May, June, and  
5 October, the percent of months exceeding the threshold under H4 would similar to or up to 26%  
6 lower (absolute scale) than the percent under NAA. The percent of months exceeding the threshold  
7 would generally be similar between NAA and H4 throughout the period, except during August, in  
8 which there would be no differences between NAA and H4.

9 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
10 Avenue Bridge during May through October (Table 11-4-88). Total degree-months exceeding the  
11 threshold would be similar between NAA and H4 throughout the period, except during September,  
12 in which total degree-months would be 13% lower under H4.

13 Due to similar flows and water temperatures between H4 and H3, results for H4 would be similar to  
14 those for H3.

#### 15 ***Stanislaus River***

16 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
17 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
18 *Analysis*). Flows under H4 would be similar to flows under NAA throughout the period.

19 Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and  
20 H4 throughout the year-round period (Appendix 11D, *Sacramento River Water Quality Model and*  
21 *Reclamation Temperature Model Results utilized in the Fish Analysis*).

#### 22 ***San Joaquin River***

23 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
24 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would  
25 be similar to flows under NAA throughout the period.

26 Water temperature modeling was not conducted in the San Joaquin River.

#### 27 ***Mokelumne River***

28 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
29 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would  
30 be similar to flows under NAA throughout the period.

31 Water temperature modeling was not conducted in the Mokelumne River.

32 ***NEPA Effects:*** Collectively, these results indicate that the effect of Alternative 4 is not adverse  
33 because it would not substantially reduce rearing habitat or substantially reduce the number of fish  
34 as a result of fry and juvenile mortality. Effects of Alternative 4 on flows and water temperatures  
35 would be small and infrequent in the Sacramento River and Clear Creek, and effects in the Feather  
36 River and the American River would be more variable, but in general, the overall effects are  
37 expected to be slightly beneficial, despite the increased flow variations Water temperatures in the  
38 Sacramento, Feather, American and Stanislaus Rivers would not be affected by Alternative 4.  
39 Reduced June through October flows under H4 in the Feather River high-flow channel would affect

1 the steelhead population there, but flows in the low-flow channel would be unaffected by H4.  
2 Overall, Alternative 4 is not expected to have biologically meaningful negative effects on steelhead  
3 rearing conditions.

4 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
5 and quality of rearing habitat for steelhead would not be affected relative to the CEQA baseline.

### 6 **H3/ESO**

#### 7 **Sacramento River**

8 Comparisons of CALSIM outputs of flow by month and water year type for the Sacramento River at  
9 Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) were used to evaluate  
10 effects of H3 compared to Existing Conditions. Results indicate negligible effects with isolated, small  
11 decreases in flow (to -17%) and more frequent, beneficial increases in flow (to 55%) throughout the  
12 year, with the exception of a greater prevalence of small to moderate flow reductions in drier water  
13 years during August, September and November (to -26%). The most substantial effects on juvenile  
14 rearing habitats would occur from reductions in flow in drier water year types in August (-26%) and  
15 September (-14%). Based on the infrequency and magnitude of these decreases, and negligible  
16 effects or beneficial increases in flow for the remainder of the year, the flow reductions are not  
17 expected to have biologically meaningful negative effects on juvenile steelhead rearing conditions in  
18 the Sacramento River.

19 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
20 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
21 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At  
22 both locations, mean monthly water temperatures under H3 would generally be similar to those  
23 under Existing Conditions, except during August through October, in which there would be 5% to  
24 6% higher temperatures under H3.

25 SacEFT predicts that there would be a 15% decrease in the percentage of years with good juvenile  
26 rearing habitat under H3 compared to Existing Conditions (Table 11-4-78). SacEFT predicts there  
27 would be a decrease of 35% in occurrence of years with “good” conditions for juvenile stranding risk  
28 (Table 11-4-78). This would contribute incrementally to decreased juvenile habitat conditions and  
29 could increase the potential for mortality due to stranding.

30 Based on the incremental effects of reductions in mean monthly flows (up to 26% lower) for several  
31 months during drier water year types, including the warmer summer/early fall months of August  
32 and September, and increased risk of juvenile stranding (35%), effects of H3 on flows would have  
33 biologically meaningful effects on juvenile rearing conditions in the Sacramento River.

#### 34 **Clear Creek**

35 Comparisons of mean monthly flows for Clear Creek were used to evaluate effects of H3 relative to  
36 Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower  
37 flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry  
38 and juveniles leading to mortality. Effects of H3 year-round consist primarily of no change (0%) or  
39 negligible change (<5%) with respect to Existing Conditions, with the exception of isolated  
40 decreases in flow in critical years during August (-25%), September (-28%), and October (-6%), and  
41 occasional increases in flow (to 54% during January in wet years; otherwise to 17% and typically in

1 wet or critical years) that would have beneficial effects. The decreases in flow would be of a  
2 frequency and magnitude to not cause biologically meaningful negative effects.

3 Evaluation of minimum instream flows for H3 relative to Existing Conditions (Table 11-4-84)  
4 indicates no effect (0%) for above normal and below normal years, and decreases for the remaining  
5 water year types (-50 cfs or -100%). This reduction corresponds to a substantial decrease in total  
6 flow during drier water years based on relatively small quantities of flow (e.g., as low as 85 cfs in the  
7 summer months in drier water years, and more typically between 150 and 200 in other months).  
8 These reductions in minimum instream flows would affect juvenile rearing habitat and could  
9 increase stranding risk, particularly in drier water years.

10 No water temperature modeling was conducted in Clear Creek.

11 While effects of H3 on mean monthly flow would consist predominantly of negligible effects, there  
12 would be moderate to substantial reductions in minimum instream flows, particularly during drier  
13 water years, that would affect juvenile rearing habitat and increase stranding risk in Clear Creek.

#### 14 **Feather River**

15 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and  
16 rearing. There would be no change in flows for H3 relative to Existing Conditions in the low-flow  
17 channel (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 Comparisons using CALSIM data by month and water year type for the Feather River at Thermalito  
19 (high-flow channel) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate  
20 variable effects of H3 relative to Existing Conditions. H3 would cause some substantial increases in  
21 mean monthly flows for some months and water year types. With some exceptions for specific water  
22 year types, there would be increases in mean monthly flows during March through June (to 135%),  
23 wetter years during July through September (to 209%), and October (to 33%). These are some of  
24 the most substantial flow increases calculated for H3 relative to Existing Conditions; effects in drier  
25 water year types would be particularly beneficial for juvenile rearing habitats. H3 would cause  
26 decreases in mean monthly flow for some of the remaining months/water year types; moderate  
27 (greater than approximately 12%) decreases would occur in drier water year types (with greater  
28 potential for adverse effects) during January (-46% in below normal years), February (-45% in  
29 below normal years and -10% in dry years), March (-53% in below normal years), July (to -61% in  
30 all drier year types), and September (to -46% in below normal and dry years). This constitutes a  
31 fairly broad range of substantial flow reductions throughout the year occurring in drier water years  
32 when potential effects on juvenile rearing conditions would be greatest.

33 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
34 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
35 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature  
36 Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water  
37 temperatures under H3 would be similar to those under Existing Conditions between April and  
38 September, but would be 5% to 10% higher between October and March. In the high-flow channel,  
39 mean monthly water temperatures under H3 would be 5% to 8% higher than those under Existing  
40 Conditions during October through February, and similar in the remaining months.

41 Effects of H3 on water temperature-related juvenile rearing conditions for steelhead in the Feather  
42 River were analyzed by comparing the percent of months between May through August over the 82-  
43 year CALSIM modeling period that exceed a 63°F temperature threshold in the low-flow channel

1 (above Thermalito Afterbay) and by comparing the percent of months between October and April  
2 that exceed a 56°F threshold at Gridley. Results for the low-flow channel (above Thermalito  
3 Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and egg  
4 incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low-flow channel and at Gridley,  
5 there would generally be moderate to large increases in the percent of months exceeding the  
6 threshold between H3 and Existing Conditions. This comparison includes the effects of climate  
7 change.

8 The effects of H3 on water temperature-related juvenile rearing conditions for spring-run Chinook  
9 salmon in the Feather River were also analyzed by comparing the total degree-months for months  
10 that exceed the 63°F NMFS threshold during May through August in the low-flow channel and the  
11 56°F threshold during October through April at Gridley. Results for the low-flow channel (above  
12 Thermalito Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and  
13 egg incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low-flow channel and at  
14 Gridley, there would be moderate to large increases in total degree-months exceeding the  
15 temperature threshold during some months. This comparison includes the effects of climate change.

16 Overall in the Feather River, effects of H3 on mean monthly flow would consist of substantial  
17 increases and decreases for various months and water year types. There would be relatively  
18 frequent, substantial flow reductions in drier water years that would affect juvenile rearing habitat  
19 conditions and contribute to stranding risk. Further, there would be moderate to large increases in  
20 the exceedance of temperature thresholds in the low-flow channel and at Gridley.

### 21 **American River**

22 CALSIM outputs were used to compare mean monthly flows by month and water year type for H3  
23 for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model*  
24 *Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for rearing  
25 and rapid reductions in flow can strand fry and juveniles leading to mortality. Comparisons of H3 to  
26 Existing Conditions indicate highly variable results, with primarily decreases in mean monthly flow  
27 for H3 relative to Existing Conditions, but some moderate increases in flow for certain months and  
28 water year types. Increases would primarily occur during January through March and June, with the  
29 largest increases generally occurring in wetter water years (to 25%) and less prevalent and/or  
30 smaller flow increases in drier water years. There would be primarily decreases in mean monthly  
31 flow during January in drier water years (to -19%), and for most water year types during May, and  
32 July through December (to -54%). The effects of H3 on mean monthly flow would consist of  
33 decreases in mean monthly flow in below normal, dry, and/or critical water years during each  
34 month of the year with reductions ranging from -9% to -54% depending on the specific month and  
35 water year type. This constitutes prevalent, substantial reductions in mean monthly flow,  
36 particularly during drier water years, that would have biologically meaningful effects on juvenile  
37 rearing conditions in the American River.

38 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
39 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
40 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
41 *utilized in the Fish Analysis*). Mean monthly water temperature under H3 would be 5% to 11% lower  
42 than those under Existing Conditions during January through March, May, and September through  
43 November, and similar in the remaining 5 months.

1 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
2 Avenue Bridge was evaluated during May through October (Table 11-4-85). The percent of months  
3 under H3 would be greater by up to 75% (absolute difference) than those under Existing Conditions  
4 during all months examined.

5 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
6 Avenue Bridge during May through October (Table 11-4-86). Total degree-months exceeding the  
7 threshold under H3 would be 74% to 3,033% greater than those under Existing Conditions for all  
8 months.

9 These results indicate that effects of H3 on flows (reductions to -54% during each month of the year  
10 in drier water year types) and water temperatures would affect juvenile steelhead rearing  
11 conditions in the American River throughout most of the year, particularly during drier water years.

### 12 ***Stanislaus River***

13 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
14 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
15 *Analysis*). There would be flow reductions (up to 36%) under H3 relative to Existing Conditions in all  
16 months.

17 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
18 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,  
19 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
20 *Fish Analysis*). Mean monthly water temperatures under H3 would be 5% to 6% lower in all months  
21 except June, July, and October.

### 22 ***San Joaquin River***

23 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
24 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would  
25 be 5% to 33% lower than flows under Existing Conditions during May through October, similar to  
26 flows under Existing Conditions during November through April.

27 Water temperature modeling was not conducted in the San Joaquin River.

### 28 ***Mokelumne River***

29 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
30 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would  
31 be similar to flows under Existing Conditions during March, up to 14% greater than flows under  
32 Existing Conditions during December through February, and up to 46% lower than flows under  
33 Existing Conditions during the remaining 8 months.

34 Water temperature modeling was not conducted in the Mokelumne River.

## 35 **H1/LOS**

### 36 ***Sacramento River***

37 Year-round flows in the Sacramento River at Keswick and upstream of Red Bluff under H1 would  
38 generally be similar to flows under H3, except during September and November, during which flows

1 would be up to 46% lower than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in*  
2 *the Fish Analysis*). These isolated reductions would not have biologically meaningful effects on  
3 steelhead fry and juvenile rearing habitat.

4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
5 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
6 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
7 monthly water temperatures under H1 would be 5% to 6% higher under H1 than those under  
8 Existing Conditions during August through October, but would not differ in other months.

9 Due to similar flows and water temperatures between H1 and H3, results for additional analyses  
10 (e.g., SacEFT, minimum mean monthly flow comparisons) under H1 would be similar to results for  
11 analyses under H3. As a result, these additional analyses were not conducted for H1. Overall, results  
12 for H1 would be similar to those for H3.

### 13 **Clear Creek**

14 Year-round flows in the Clear Creek under H1 would generally be similar to flows under H3  
15 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature  
16 modeling was conducted in Clear Creek. Due to similar flows between H1 and H3, results for  
17 additional analyses (e.g., minimum mean monthly flow comparisons) under H1 would be similar to  
18 results for analyses under H3. As a result, these additional analyses were not conducted for H1.  
19 Overall, results for H1 would be similar to those for H3.

### 20 **Feather River**

21 Year-round flows in the Feather River above Thermalito Afterbay (low-flow channel) under H1  
22 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
23 *Fish Analysis*). Year-round flows in the Feather River below Thermalito Afterbay (high-flow channel)  
24 under H1 would generally be similar to or greater than flows under H3, except during September  
25 during which flows would be up to 83% lower than flows under NAA. This isolated reduction would  
26 not have biologically meaningful effects on steelhead fry and juvenile rearing habitat.

27 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
28 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
29 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*  
30 *Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water  
31 temperatures under H1 would be similar to those under Existing Conditions between April and  
32 September, but would be 5% to 9% higher between October and March. In the high-flow channel,  
33 mean monthly water temperatures under H1 would be 6% to 8% higher than those under Existing  
34 Conditions during October through February, and similar in the remaining months.

35 The analysis evaluating the percent of months exceeding water temperature thresholds from NMFS  
36 presented in Impacts AQUA-59 and AQUA-76 indicates that there would be a small to moderate  
37 negative effects of H1 relative to Existing Conditions in multiple months in the low flow channel and  
38 at Gridley. This comparison includes the effects of climate change.

39 The analysis evaluating the total degree-months exceeding water temperature thresholds from  
40 NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that there would be small to moderate  
41 negative effects of H1 relative to Existing Conditions in multiple months in the low flow channel and  
42 at Gridley. This comparison includes the effects of climate change.

1 May and September Oroville storage under H1 would generally be similar to or greater than storage  
2 under H3 (Table 11-4-45, Table 11-4-39).

3 Due to similar flows and water temperatures, and similar or greater reservoir storage under H1  
4 compared to H3, results for H1 would be similar to or better than those for H3.

#### 5 **American River**

6 Year-round flows in the American River at the confluence with the Sacramento River under H1  
7 would generally be similar to flows under H3, except during September, during which flows would  
8 be up to 38% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These isolated  
9 flow reductions would not have biologically meaningful effects on steelhead fry and juvenile habitat  
10 because they only occur during one of 12 months.

11 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
12 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
13 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
14 *utilized in the Fish Analysis*). Mean monthly water temperature under H1 would be 5% to 10% lower  
15 than those under Existing Conditions during August through March and May through December, and  
16 similar in the remaining 3 months.

17 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
18 Avenue Bridge was evaluated during May through October (Table 11-4-87). The percent of months  
19 under H1 would be greater by up to 46% (absolute difference) than those under Existing Conditions  
20 during all months examined.

21 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
22 Avenue Bridge during May through October (Table 11-4-88). Total degree-months exceeding the  
23 threshold under H1 would be 77% to 2,617% greater than those under Existing Conditions for all  
24 months.

25 Due to similar flows and water temperatures between H1 and H3, results for H1 would be similar to  
26 those for H3.

#### 27 **Stanislaus River**

28 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
29 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
30 *Analysis*). There would be flow reductions (up to 36%) under H1 relative to Existing Conditions in all  
31 months.

32 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
33 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,  
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
35 *Fish Analysis*). Mean monthly water temperatures under H1 would be 5% to 6% lower in all months  
36 except June, July, and October.

#### 37 **San Joaquin River**

38 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
39 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would

1 be 5% to 33% lower than flows under Existing Conditions during May through October, similar to  
2 flows under Existing Conditions during November through April.

3 Water temperature modeling was not conducted in the San Joaquin River.

#### 4 ***Mokelumne River***

5 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
6 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 would  
7 be similar to flows under Existing Conditions during March, up to 14% greater than flows under  
8 Existing Conditions during December through February, and up to 46% lower than flows under  
9 Existing Conditions during the remaining 8 months.

10 Water temperature modeling was not conducted in the Mokelumne River.

#### 11 **H4/HOS**

#### 12 ***Sacramento River***

13 Year-round flows in the Sacramento River at Keswick and upstream of Red Bluff under H4 would  
14 generally be similar to flows under H3, except during May and June, during which flows would be up  
15 to 13% lower than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
16 *Analysis*). These small and isolated reductions would not have biologically meaningful effects on  
17 steelhead fry and juvenile rearing habitat.

18 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were  
19 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*  
20 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At  
21 both locations, mean monthly water temperatures under H4 would generally be similar to those  
22 under Existing Conditions, except during August through October, in which there would be 5% to  
23 6% higher temperatures under H4.

24 Due to similar flows and water temperatures between H4 and H3, results for additional analyses  
25 (e.g., SacEFT, minimum mean monthly flow comparisons) under H4 would be similar to results for  
26 analyses under H3. As a result, these additional analyses were not conducted for H4. Overall, results  
27 for H4 would be similar to those for H3.

#### 28 ***Clear Creek***

29 Year-round flows in the Clear Creek under H4 would generally be similar to flows under H3  
30 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature  
31 modeling was conducted in Clear Creek. Due to similar flows between H4 and H3, results for  
32 additional analyses (e.g., minimum mean monthly flow comparisons) under H4 would be similar to  
33 results for analyses under H3. As a result, these additional analyses were not conducted for H4.  
34 Overall, results for H4 would be similar to those for H3.

#### 35 ***Feather River***

36 Year-round flows in the Feather River above Thermalito Afterbay (low-flow channel) under H4  
37 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
38 *Fish Analysis*). Flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4  
39 during January through May and November through December would generally be similar to or

1 greater than flows under H3. However, flows during June through October would generally be up to  
2 39% lower under H4. Despite these differences, very few steelhead rear in the high-flow channel  
3 and, therefore, these reductions are not expected to cause a biologically meaningful effect.

4 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at  
5 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile  
6 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature  
7 Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water  
8 temperatures under H1 would be similar to those under Existing Conditions between April and  
9 September, but would be 5% to 19% higher between October and March. In the high-flow channel,  
10 mean monthly water temperatures under H1 would be 5% to 8% higher than those under Existing  
11 Conditions during July, August, and October through February, and similar in the remaining 5  
12 months.

13 The analysis evaluating the percent of months exceeding water temperature thresholds from NMFS  
14 presented in Impacts AQUA-59 and AQUA-76 indicates that there would be a small to moderate  
15 negative effects of H4 relative to Existing Conditions in multiple months in the low flow channel and  
16 at Gridley. This comparison includes the effects of climate change.

17 The analysis evaluating the total degree-months exceeding water temperature thresholds from  
18 NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that there would be small to moderate  
19 negative effects of H4 relative to Existing Conditions in multiple months in the low flow channel and  
20 at Gridley. This comparison includes the effects of climate change.

21 May storage would be 11% to 15% lower under H4 relative to H3 in wet, above normal, and below  
22 normal water years (Table 11-4-45). September Oroville storage under H4 would generally be  
23 similar to or greater than storage under H4 (Table 11-4-39).

#### 24 **American River**

25 Year-round flows in the American River at the confluence with the Sacramento River under H4  
26 would generally be similar to flows under H3, except during June and October, during which flows  
27 would be up to 22% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These  
28 isolated flow reductions would not have biologically meaningful effects on steelhead fry and juvenile  
29 habitat because they only occur during two of 12 months.

30 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
31 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period  
32 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results  
33 utilized in the Fish Analysis*). Mean monthly water temperature under H4 would be 5% to 11% lower  
34 than those under Existing Conditions during May and August through March, and similar in the  
35 remaining 3 months.

36 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt  
37 Avenue Bridge was evaluated during May through October (Table 11-4-87). The percent of months  
38 under H4 would be greater by up to 72% (absolute difference) than those under Existing Conditions  
39 during all months examined.

40 Total degree-months exceeding 65°F were summed by month and water year type at the Watt  
41 Avenue Bridge during May through October (Table 11-4-88). Total degree-months exceeding the

1 threshold under H4 would be 68% to 2,917% greater than those under Existing Conditions for all  
2 months.

3 Due to similar flows and water temperatures between H4 and H3, results for H4 would be similar to  
4 those for H3.

#### 5 ***Stanislaus River***

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the  
7 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
8 *Analysis*). There would be flow reductions (up to 36%) under H4 relative to Existing Conditions in all  
9 months.

10 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
11 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,  
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
13 *Fish Analysis*). Mean monthly water temperatures under H4 would be 5% to 6% lower in all months  
14 except June, July, and October.

#### 15 ***San Joaquin River***

16 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing  
17 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would  
18 be 5% to 33% lower than flows under Existing Conditions during May through October, similar to  
19 flows under Existing Conditions during November through April.

20 Water temperature modeling was not conducted in the San Joaquin River.

#### 21 ***Mokelumne River***

22 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing  
23 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 would  
24 be similar to flows under Existing Conditions during March, up to 14% greater than flows under  
25 Existing Conditions during December through February, and up to 46% lower than flows under  
26 Existing Conditions during the remaining 8 months.

27 Water temperature modeling was not conducted in the Mokelumne River.

#### 28 **Summary of CEQA Conclusion**

29 Collectively, these results of the Impact AQUA-95 CEQA analysis indicate that the difference between  
30 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
31 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
32 a result of fry and juvenile mortality, contrary to the NEPA conclusion set forth above. Juvenile  
33 rearing conditions in all locations analyzed would be negatively affected under Alternative 4 by  
34 moderate to substantial reductions in mean monthly flows for large portions of the year-round  
35 rearing period in the Feather, American, Stanislaus, San Joaquin, and Mokelumne Rivers. Water  
36 temperatures and the exceedances above applicable NMFS thresholds would be higher in the  
37 Sacramento, Feather, American, and Stanislaus Rivers. Degraded rearing conditions for juvenile  
38 steelhead would reduce their survival and growth in these waterways.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and H3 indicates that flows in the locations and during the months  
14 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
15 indicates that the differences between Existing Conditions and Alternative 4 found above would  
16 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
17 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
18 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
19 impact on rearing habitat for steelhead. This impact is found to be less than significant and no  
20 mitigation is required.

## 21 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

### 22 **Upstream of the Delta**

23 In general, the effects of Alternative 4 on steelhead migration conditions relative to the NAA are  
24 uncertain.

### 25 **H3/ESO**

#### 26 ***Sacramento River***

##### 27 *Juveniles*

28 Sacramento River flow upstream of Red Bluff during the juvenile steelhead migration period  
29 (October through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) is used  
30 to represent flow conditions in the mainstem of the upper river below Keswick Dam. Flows under  
31 H3 during this period would generally be similar to flows under NAA, except during November,  
32 during which flows would be up to 18% lower than flows under NAA. These reductions would not  
33 have a biologically meaningful effect on steelhead juvenile migration because reductions occur  
34 during only one of eight months of the period.

35 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
36 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
37 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
38 There would be no differences (<5%) in mean monthly water temperature between NAA and H3 in  
39 any month or water year type throughout the period.

40 Overall, these results indicate that H3 would not have biologically meaningful effects on juvenile  
41 migration conditions.

1       **Adults**

2       Instream flows upstream of Red Bluff were compared monthly over the period from September  
3       through March under H3 and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
4       *Analysis*). Flows under H3 during this period would generally be similar to flows under NAA, except  
5       during November, during which flows would be up to 18% lower than flows under NAA. These  
6       reductions would not have a biologically meaningful effect on steelhead adult migration because  
7       reductions occur during only one of seven months of the period.

8       Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
9       during the September through March steelhead adult upstream migration period (Appendix 11D,  
10       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
11       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
12       NAA and H3 in any month or water year type throughout the period.

13       **Kelts**

14       Average Sacramento River flows upstream of Red Bluff under H3 during March and April (Appendix  
15       11C, *CALSIM II Model Results utilized in the Fish Analysis*) would generally be similar to flows under  
16       NAA. Therefore, H3 would not affect kelt migration in the Sacramento River.

17       Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
18       during the March through April steelhead kelt downstream migration period (Appendix 11D,  
19       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
20       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
21       NAA and H3 in any month or water year type throughout the period.

22       Overall in the Sacramento River, these results indicate that H3 would not have biologically  
23       meaningful effects on juvenile, adult, or kelt steelhead migration in the Sacramento River.

24       **Clear Creek**

25       No water temperature modeling was conducted in Clear Creek.

26       **Juveniles**

27       Flows in Clear Creek at Whiskeytown were evaluated for the juvenile steelhead migration period  
28       (October through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
29       under H3 would be similar to or greater than flows under NAA throughout the period. These results  
30       indicate that effects of H3 on flows would not affect juvenile steelhead migration conditions in Clear  
31       Creek.

32       **Adults**

33       Flows in Clear Creek at Whiskeytown were evaluated for the September through March adult  
34       steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
35       Flows under H3 would be similar to or greater than flows under NAA throughout the period. These  
36       results indicate that effects of Alternative 4 on flows would not affect adult steelhead migration  
37       conditions in Clear Creek.

1 **Kelts**

2 Flows in Clear Creek at Whiskeytown were evaluated for the March through April kelt steelhead  
3 migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
4 H3 would be similar to or greater than flows under NAA throughout the period. These results  
5 indicate that H3 would not affect kelt steelhead migration conditions in Clear Creek.

6 Overall in Clear Creek, these results indicate that effects of H3 on flows would not affect juvenile,  
7 adult, or kelt steelhead migration.

8 **Feather River**

9 **Juveniles**

10 Flows in the Feather River at Thermalito Afterbay (high-flow channel) and at the confluence with  
11 the Sacramento River were evaluated during the October through May juvenile steelhead migration  
12 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the high-flow  
13 channel under H3 would generally be similar to or greater than flows under NAA throughout the  
14 period. Increases in flow would have a beneficial effect on migration conditions, particularly in drier  
15 water years during some months (up to 54% greater flows).

16 Flows under H3 in the Feather River at the confluence with the Sacramento River during October  
17 through May would generally be similar to or greater than flows under NAA, except in above normal  
18 water years during November (6% lower) and December (8% lower) (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*). These isolated reductions would not have biologically  
20 meaningful effects on juvenile steelhead migration conditions.

21 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
22 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
25 NAA and H3 in any month or water year type throughout the period.

26 Overall, there would be no biologically meaningful effects H3 on juvenile migration conditions in the  
27 Feather River.

28 **Adults**

29 Flows in the Feather River at Thermalito Afterbay (high-flow channel) and at the confluence with  
30 the Sacramento River were evaluated during the September through March adult migration period  
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). e Flows in the high-flow  
32 channel under H3 would generally be similar to or greater than flows under NAA, except during  
33 September, in which flows would be up to 42% lower depending on water year type. These flow  
34 reductions would be isolated and would, therefore, not have a biologically meaningful effect on adult  
35 steelhead migration conditions. Flows in the Feather River at the confluence with the Sacramento  
36 River under H3 would generally be similar to or greater than flows under NAA, except during  
37 September, in which flows would be up to 27% lower depending on water year type. These flow  
38 reductions would be isolated and would, therefore, not have a biologically meaningful effect on adult  
39 steelhead migration conditions.

40 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
41 were evaluated during the September through March steelhead adult upstream migration period

1 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
2 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
3 temperature between NAA and H3 in any month or water year type throughout the period.

#### 4 *Kelts*

5 Flows in the Feather River at the Thermalito Afterbay and at the confluence with the Sacramento  
6 River were evaluated during the March and April kelt migration period. Flows at Thermalito under  
7 H3 during March and April would generally be similar to or up to 54% greater than flows under  
8 NAA. Flows at the confluence with the Sacramento River would generally be similar to or up to 14%  
9 greater than flows under NAA. These results indicate that H3 would not affect kelt steelhead  
10 migration conditions in the Feather River.

11 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
12 were evaluated during the March through April steelhead kelt downstream migration period  
13 (*Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
14 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
15 temperature between NAA and H3 in any month or water year type throughout the period.

16 Overall in the Feather River, H3 would not have biologically meaningful effects on juvenile, adult, or  
17 kelt steelhead migration.

#### 18 **American River**

##### 19 *Juveniles*

20 Flows in the American River at the confluence with the Sacramento River (*Appendix 11C, CALSIM II*  
21 *Model Results utilized in the Fish Analysis*) were evaluated for the juvenile steelhead migration period  
22 (October through May). Flows under H3 would generally be similar to flows under NAA, except  
23 during November, in which flows would be up to 8% lower depending on water year type, and  
24 during May, in which flows would be up to 24% greater depending on water year type. Increases  
25 and decreases would be too rare to have biologically meaningful effects on juvenile steelhead  
26 migration.

27 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
28 River were evaluated during the October through May juvenile steelhead migration period  
29 (*Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
30 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
31 temperature between NAA and H3 in any month or water year type throughout the period.

32 Based on generally negligible effects or increases in mean monthly flow and negligible effects on  
33 water temperature, effects of H3 on flows would not affect juvenile steelhead migration in the  
34 American River.

##### 35 *Adults*

36 Flows in the American River at the confluence with the Sacramento River (*Appendix 11C, CALSIM II*  
37 *Model Results utilized in the Fish Analysis*) were evaluated for the September through March adult  
38 migration period. Flows would generally be similar to flows under NAA, except during September  
39 and November, in which flows would be up to 18% lower depending on month and water year type.

1 These reductions would be too rare to cause biologically meaningful effects on adult steelhead  
2 migration.

3 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
4 River were evaluated during the September through March steelhead adult upstream migration  
5 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
6 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
7 temperature between NAA and H3 in any month or water year type throughout the period.

#### 8 *Kelts*

9 Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
10 *Model Results utilized in the Fish Analysis*) were evaluated for the March through April kelt migration  
11 period. Flows under H3 would generally be similar to flows under NAA during this period, except for  
12 small reductions in flows in dry and critical years during March (5% to 6% lower).

13 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
14 River were evaluated during the March through April steelhead kelt downstream migration period  
15 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
16 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
17 temperature between NAA and H3 in any month or water year type throughout the period.

18 Overall in the American River, the effects of H3 on flows would not affect juvenile, adult, or kelt  
19 migration conditions.

#### 20 ***Stanislaus River***

21 Flows in the Stanislaus River at the confluence with the San Joaquin River for H3 are not different  
22 from flows under NAA for any month. Therefore, there would be no effect of H3 on juvenile, adult, or  
23 kelt migration in the Stanislaus River.

24 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San  
25 Joaquin River for H3 are not different from flows under NAA for any month. Therefore, there would  
26 be no effect of H3 on juvenile, adult, or kelt migration in the Stanislaus River.

#### 27 ***San Joaquin River***

28 Flows in the San Joaquin River at Vernalis for H3 are not different from flows under NAA for any  
29 month. Therefore, there would be no effect of H3 on juvenile, adult, or kelt migration in the San  
30 Joaquin River.

31 Water temperature modeling was not conducted in the San Joaquin River.

#### 32 ***Mokelumne River***

33 Flows in the Mokelumne River at the Delta for H3 are not different from flows under NAA for any  
34 month. Therefore, there would be no effect of H3 on juvenile, adult, or kelt migration in the  
35 Mokelumne River.

36 Water temperature modeling was not conducted in the Mokelumne River.

1 **H1/LOS**

2 ***Sacramento River***

3 *Juveniles*

4 Flows under H1 in the Sacramento River upstream of Red Bluff during the October through May  
5 juvenile steelhead migration period would generally be similar to flows under H3, except during  
6 November, in which flows would be up to 12% lower depending on water year type (Appendix 11C,  
7 *CALSIM II Model Results utilized in the Fish Analysis*). This reduction would not occur at a high  
8 enough frequency to have a meaningful effect on juvenile steelhead migration habitat.

9 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
10 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
11 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
12 There would be no differences (<5%) in mean monthly water temperature between NAA and H1 in  
13 any month or water year type throughout the period.

14 Overall, results for H1 would be similar to those for H3.

15 *Adults*

16 Flows under H1 in the Sacramento River upstream of Red Bluff during the September through  
17 March adult steelhead migration period would generally be similar to flows under H3, except during  
18 November, in which flows would be up to 12% lower depending on water year type (Appendix 11C,  
19 *CALSIM II Model Results utilized in the Fish Analysis*). This reduction would not occur at a high  
20 enough frequency to have a meaningful effect on juvenile steelhead migration habitat.

21 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
22 during the September through March steelhead adult upstream migration period (Appendix 11D,  
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
25 NAA and H1 in any month or water year type throughout the period.

26 Overall results for H1 would be similar to those for H3.

27 *Kelts*

28 Flows under H1 in the Sacramento River upstream of Red Bluff during the March through April adult  
29 steelhead migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
30 *Model Results utilized in the Fish Analysis*).

31 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
32 during the March through April steelhead kelt downstream migration period (Appendix 11D,  
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
34 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
35 NAA and H1 in any month or water year type throughout the period.

36 Overall results for H1 would be similar to those for H3.

37 ***Clear Creek***

38 No water temperature modeling was conducted in Clear Creek.

1        *Juveniles*

2        Flows under H1 in Clear Creek at Whiskeytown during the October through May juvenile migration  
3        period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
4        *in the Fish Analysis*). Overall results for H1 would be similar to those for H3.

5        *Adults*

6        Flows under H1 in Clear Creek at Whiskeytown during the September through March adult  
7        migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
8        *Results utilized in the Fish Analysis*). Overall results for H1 would be similar to those for H3.

9        *Kelts*

10       Flows under H1 in Clear Creek at Whiskeytown during the March through April kelt migration  
11       period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
12       *in the Fish Analysis*). Overall results for H1 would be similar to those for H3.

13       **Feather River**

14       *Juveniles*

15       Flows under H1 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
16       River during the October through May juvenile migration period would generally be similar to or  
17       greater than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18       Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
19       were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
20       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
21       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
22       NAA and H1 in any month or water year type throughout the period.

23       Overall results for H1 would be similar to those for H3.

24       *Adults*

25       Flows under H1 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
26       River during the September through March adult migration period would generally be similar to or  
27       greater than flows under H3, except during September, in which flows would be up to 83% lower  
28       depending on water year type and location (Appendix 11C, *CALSIM II Model Results utilized in the*  
29       *Fish Analysis*). Although large, these flow reductions would not have biologically meaningful effects  
30       because they occur in only one of seven months.

31       Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
32       were evaluated during the September through March steelhead adult upstream migration period  
33       (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
34       *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
35       temperature between NAA and H1 in any month or water year type throughout the period.

36       Overall results for H1 would be similar to those for H3.

1 **Kelts**

2 Flows under H1 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
3 River during the March through April kelt migration period would generally be similar to or greater  
4 than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
6 were evaluated during the March through April steelhead kelt downstream migration period  
7 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
8 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
9 temperature between NAA and H1 in any month or water year type throughout the period.

10 Overall results for H1 would be similar to those for H3.

11 **American River**

12 **Juveniles**

13 Flows under H1 in the American River at the confluence with the Sacramento River during the  
14 October through May juvenile migration period would generally be similar to flows under H3 with  
15 few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
17 River were evaluated during the October through May juvenile steelhead migration period  
18 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
19 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
20 temperature between NAA and H1 in any month or water year type throughout the period.

21 Overall results for H1 would be similar to those for H3.

22 **Adults**

23 Flows under H1 in the American River at the confluence with the Sacramento River during the  
24 September through March adult migration period would generally be similar to flows under H3 with  
25 few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
27 River were evaluated during the September through March steelhead adult upstream migration  
28 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
29 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
30 temperature between NAA and H3 in any month or water year type throughout the period.

31 Overall results for H1 would be similar to those for H3.

32 **Kelts**

33 Flows under H1 in the American River at the confluence with the Sacramento River during the  
34 March through April kelt migration period would generally be similar to flows under H3 with few  
35 exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
37 River were evaluated during the March through April steelhead kelt downstream migration period  
38 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*

1 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
2 temperature between NAA and H1 in any month or water year type throughout the period.

3 Overall results for H1 would be similar to those for H3.

#### 4 ***Stanislaus River***

5 Flows in the Stanislaus River at the confluence with the San Joaquin River for H1 are not different  
6 from flows under NAA for any month. Therefore, there would be no effect of H1 on juvenile, adult, or  
7 kelt migration in the Stanislaus River.

8 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San  
9 Joaquin River for H1 are not different from flows under NAA for any month. Therefore, there would  
10 be no effect of H1 on juvenile, adult, or kelt migration in the Stanislaus River.

#### 11 ***San Joaquin River***

12 Flows in the San Joaquin River at Vernalis for H1 are not different from flows under NAA for any  
13 month. Therefore, there would be no effect of H1 on juvenile, adult, or kelt migration in the San  
14 Joaquin River.

15 Water temperature modeling was not conducted in the San Joaquin River.

#### 16 ***Mokelumne River***

17 Flows in the Mokelumne River at the Delta for H1 are not different from flows under NAA for any  
18 month. Therefore, there would be no effect of H1 on juvenile, adult, or kelt migration in the  
19 Mokelumne River.

20 Water temperature modeling was not conducted in the Mokelumne River.

#### 21 **H4/HOS**

#### 22 ***Sacramento River***

##### 23 *Juveniles*

24 Flows under H4 in the Sacramento River upstream of Red Bluff during the October through May  
25 juvenile steelhead migration period would generally be similar to flows under H3 (Appendix 11C,  
26 *CALSIM II Model Results utilized in the Fish Analysis*).

27 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
28 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
29 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
30 There would be no differences (<5%) in mean monthly water temperature between NAA and H4 in  
31 any month or water year type throughout the period.

32 Overall, results for H4 would be similar to those for H3.

##### 33 *Adults*

34 Flows under H4 in the Sacramento River upstream of Red Bluff during the September through  
35 March adult steelhead migration period would generally be similar to flows under H3 (Appendix  
36 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
2 during the September through March steelhead adult upstream migration period (Appendix 11D,  
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
5 NAA and H4 in any month or water year type throughout the period.

6 Overall results for H4 would be similar to those for H3.

#### 7 *Kelts*

8 Flows under H4 in the Sacramento River upstream of Red Bluff during the March through April adult  
9 steelhead migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
10 *Model Results utilized in the Fish Analysis*).

11 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
12 during the March through April steelhead kelt downstream migration period (Appendix 11D,  
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
15 NAA and H4 in any month or water year type throughout the period.

16 Overall results for H4 would be similar to those for H3.

#### 17 **Clear Creek**

18 No water temperature modeling was conducted in Clear Creek.

#### 19 *Juveniles*

20 Flows under H4 in Clear Creek at Whiskeytown during the October through May juvenile migration  
21 period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
22 *in the Fish Analysis*). Overall results for H4 would be similar to those for H3.

#### 23 *Adults*

24 Flows under H4 in Clear Creek at Whiskeytown during the September through March adult  
25 migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
26 *Results utilized in the Fish Analysis*). Overall results for H4 would be similar to those for H3.

#### 27 *Kelts*

28 Flows under H4 in Clear Creek at Whiskeytown during the March through April kelt migration  
29 period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
30 *in the Fish Analysis*). Overall results for H4 would be similar to those for H3.

#### 31 **Feather River**

#### 32 *Juveniles*

33 Flows under H4 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
34 River during the October through May juvenile migration period would generally be similar to or  
35 greater than flows under H3, except during October, in which flows would be up to 27% lower  
36 depending on water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 These flow reductions would not cause biologically meaningful effects on juvenile steelhead  
2 migration conditions because they occur during only one of eight months during the period.

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
4 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
7 NAA and H4 in any month or water year type throughout the period.

8 Overall results for H4 would be similar to those for H3.

#### 9 *Adults*

10 Flows under H4 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
11 River during the September through March adult migration period would generally be similar to  
12 flows under H3, except during September and October, in which flows would be up to 32% lower  
13 depending on water year type and location (Appendix 11C, *CALSIM II Model Results utilized in the*  
14 *Fish Analysis*). These flow reductions would be high enough and would occur at a high enough  
15 frequency to have biologically meaningful effects on adult migration conditions.

16 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
17 were evaluated during the September through March steelhead adult upstream migration period  
18 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
19 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
20 temperature between NAA and H4 in any month or water year type throughout the period.

21 Overall results for H4 would be worse for adult migration conditions than those for H3.

#### 22 *Kelts*

23 Flows under H4 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
24 River during the March through April kelt migration period would generally be similar to or greater  
25 than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
27 were evaluated during the March through April steelhead kelt downstream migration period  
28 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
29 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
30 temperature between NAA and H4 in any month or water year type throughout the period.

31 Overall results for H4 would be similar to those for H3.

#### 32 ***American River***

##### 33 *Juveniles*

34 Flows under H4 in the American River at the confluence with the Sacramento River during the  
35 October through May juvenile migration period would generally be similar to flows under H3, except  
36 during October in which flows would be up to 13% lower under H3 (Appendix 11C, *CALSIM II Model*  
37 *Results utilized in the Fish Analysis*). These reductions would not be large or frequent enough to have  
38 biologically meaningful effects on juvenile steelhead migration conditions.

1 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
2 River were evaluated during the October through May juvenile steelhead migration period  
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
5 temperature between NAA and H4 in any month or water year type throughout the period.

6 Overall results for H4 would be similar to those for H3.

#### 7 *Adults*

8 Flows under H4 in the American River at the confluence with the Sacramento River during the  
9 September through March adult migration period would generally be similar to flows under H3,  
10 except during October in which flows would be up to 13% lower under H3 (Appendix 11C, *CALSIM II*  
11 *Model Results utilized in the Fish Analysis*). These reductions would not be large or frequent enough  
12 to have biologically meaningful effects on adult steelhead migration conditions.

13 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
14 River were evaluated during the September through March steelhead adult upstream migration  
15 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
16 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
17 temperature between NAA and H4 in any month or water year type throughout the period.

18 Overall results for H4 would be similar to those for H3.

#### 19 *Kelts*

20 Flows under H4 in the American River at the confluence with the Sacramento River during the  
21 March through April kelt migration period would generally be similar to flows under H3 (Appendix  
22 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
24 River were evaluated during the March through April steelhead kelt downstream migration period  
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
26 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
27 temperature between NAA and H4 in any month or water year type throughout the period.

28 Overall results for H4 would be similar to those for H3.

#### 29 ***Stanislaus River***

30 Flows in the Stanislaus River at the confluence with the San Joaquin River for H4 are not different  
31 from flows under NAA for any month. Therefore, there would be no effect of H4 on juvenile, adult, or  
32 kelt migration in the Stanislaus River.

33 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San  
34 Joaquin River for H4 are not different from flows under NAA for any month. Therefore, there would  
35 be no effect of H4 on juvenile, adult, or kelt migration in the Stanislaus River.

#### 36 ***San Joaquin River***

37 Flows in the San Joaquin River at Vernalis for H4 are not different from flows under NAA for any  
38 month. Therefore, there would be no effect of H4 on juvenile, adult, or kelt migration in the San  
39 Joaquin River.

1 Water temperature modeling was not conducted in the San Joaquin River.

2 ***Mokelumne River***

3 Flows in the Mokelumne River at the Delta for H4 are not different from flows under NAA for any  
4 month. Therefore, there would be no effect of H4 on juvenile, adult, or kelt migration in the  
5 Mokelumne River.

6 Water temperature modeling was not conducted in the Mokelumne River.

7 **Through-Delta**

8 ***Sacramento River***

9 *Juveniles*

10 Alternative 4 operations would generally reduce OMR reverse flows under all flow scenarios, with a  
11 corresponding increase in net positive downstream flows, during the outmigration period of  
12 steelhead through the interior Delta channels (Appendix 11C, *CALSIM II Model Results utilized in the*  
13 *Fish Analysis*). Conditions under Scenario H4 would further improve overall average OMR flows  
14 relative to other flow scenarios under Alternative 4. These improved net positive downstream flows  
15 would be substantial benefits of the proposed operations.

16 Predation at the north Delta would be increased due to the construction of the proposed SWP/CVP  
17 water export facilities on the Sacramento River. It is assumed that per capita steelhead predation  
18 losses would be similar to those predicted for spring-run Chinook salmon, although slightly reduced  
19 because of the larger size of steelhead outmigrants. Bioenergetics modeling with a median predator  
20 density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a predation loss of  
21 about 0.2% of the juvenile spring-run population (Table 11-4-26).

22 Based on DPM results for Chinook salmon (Impact 42 for Alternative 4), steelhead survival would  
23 not be expected to change more than 1% under Alternative 4. Also, steelhead juveniles are larger  
24 than Chinook salmon juveniles in general, and therefore would be less vulnerable to predation  
25 during migration. Therefore the effect on juvenile steelhead outmigration success through the Delta  
26 under Alternative 4 would not be adverse.

27 *Adults*

28 The upstream adult steelhead migration occurs from September–March, peaking during December–  
29 February. The steelhead kelt downstream migration occurs from January–April. The proportion of  
30 Sacramento River water in the Delta under Alternative 4 would be similar (<10% difference) to  
31 NAA throughout the adult steelhead upstream migration (Table 11-4-89). Under Alternative 4  
32 Scenario H3 Sacramento River flows at Rio Vista would be reduced, but the effect would similar or  
33 improved relative to Alternative 1A's effects (Impact AQUA-96) in all months of the adult upstream  
34 migration and kelt downstream migration periods, except in October. Rio Vista flows would be  
35 similar between all the flow scenarios under Alternative 4 from October–March. However, in  
36 September, average flows under Scenario H4 at Rio Vista would be 46% less compared to Scenario  
37 H3 and 67% less compared to NAA. Because the effect under Alternative 1A would not be adverse,  
38 Alternative 4 would also not have an adverse effect on adult and kelt steelhead migration through  
39 the Delta.

1 **San Joaquin River**

2 *Juveniles*

3 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of  
4 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.  
5 There no flow changes associated with the Alternatives. Alternative 4 would have no effect on  
6 steelhead migration success through the Delta.

7 *Adults*

8 Alternative 4 Scenario H3 would slightly increase the proportion of San Joaquin River water in the  
9 Delta in September through December by 1.1 to 3.9 % (compared to NAA) (Table 11-4-89). The  
10 proportion of San Joaquin River water under Scenario H3 would be similar or slightly more than  
11 NAA. Conditions under Scenario H4 are expected to reduce the magnitude of this effect because it  
12 would involve fewer exports from the north Delta compared to Scenario H3 and the LOS.

13 **Table 11-4-89. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**  
14 **San Joaquin River during the Adult Steelhead Migration Period for Alternative 4**

Month	EXISTING CONDITIONS	NAA	A4	EXISTING CONDITIONS vs. A4	NAA vs. A4
<b>Sacramento River</b>					
September	60	65	63	3	-2
October	60	68	67	7	-1
November	60	66	63	3	-3
December	67	66	66	-1	0
January	76	75	73	-3	-2
February	75	72	68	-7	-4
March	78	76	68	-10	-8
<b>San Joaquin River</b>					
September	0.3	0.1	1.2	0.9	1.1
October	0.2	0.3	3.3	3.1	3
November	0.4	1.0	4.9	4.5	3.9
December	0.9	1.0	2.9	2	1.9
January	1.6	1.7	3.1	1.5	1.4
February	1.4	1.5	3.4	2	1.9
March	2.6	2.8	5.5	2.9	2.7
Shading indicates 10% or greater absolute difference.					

15

16 **NEPA Effects:** Upstream of the Delta, these results indicate that the effect is not adverse because it  
17 would not substantially reduce the amount of suitable habitat or substantially interfere with the  
18 movement of fish. Effects of Alternative 4 in all locations analyzed would consist primarily of  
19 negligible effects on mean monthly flow and water temperatures for the juvenile, adult, and kelt  
20 migration periods. Effects of Alternative 4 on upstream water temperatures would also be  
21 negligible.

1 Near-field effects of Alternative 4 NDD on Sacramento River steelhead related to impingement and  
2 predation associated with three new intake structures could result in negative effects on juvenile  
3 migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected  
4 that the level of near-field impacts would be directly correlated to the number of new intake  
5 structures in the river and thus the level of impacts associated with 3 new intakes would be  
6 considerably lower than those expected from having 5 new intakes in the river. Estimates within the  
7 effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~  
8 12% mortality above current baseline levels). CM15 would be implemented with the intent of  
9 providing localized and temporary reductions in predation pressure at the NDD. Additionally,  
10 several pre-construction surveys to better understand how to minimize losses associated with the  
11 three new intake structures will be implemented as part of the final NDD screen design effort.  
12 Alternative 4 also includes an Adaptive Management Program and Real-Time Operational Decision-  
13 Making Process to evaluate and make limited adjustments intended to provide adequate migration  
14 conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere  
15 in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the  
16 NDD remains highly uncertain.

17 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with  
18 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of  
19 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 4  
20 predict improvements in smolt condition and survival associated with increased access to the Yolo  
21 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude  
22 of each of these factors and how they might interact and/or offset each other in affecting salmonid  
23 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

24 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of  
25 all of these elements of BDCP operations and conservation measures to predict smolt migration  
26 survival throughout the entire Plan Area. The current draft of this model predicts that smolt  
27 migration survival under Alternative 4 would be similar to those estimated for NAA. Further  
28 refinement and testing of the DPM, along with several ongoing and planned studies related to  
29 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable  
30 future. These efforts are expected to improve our understanding of the relationships and  
31 interactions among the various factors affecting salmonid survival, and reduce the uncertainty  
32 around the potential effects of BDCP implementation on migration conditions for steelhead.  
33 However, until these efforts are completed and their results are fully analyzed, the overall  
34 cumulative effect of Alternative 4 on steelhead migration remains uncertain.

35 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
36 and quality of migration habitat for steelhead would not be reduced relative to Existing Conditions.

## 37 **Upstream of the Delta**

### 38 **H3/ESO**

#### 39 ***Sacramento River***

##### 40 *Juveniles*

41 Flows in the Sacramento River just upstream of Red Bluff Diversion Dam were evaluated for the  
42 juvenile migration period (October through May) (Appendix 11C, *CALSIM II Model Results utilized in*

1 *the Fish Analysis*). Effects of H3 compared to Existing Conditions consist primarily of negligible  
2 effects (<5%) during October through May, with small increases (to 15%) or decreases (to -17%) in  
3 flow. Increases would have a beneficial effect on migration conditions and decreases would be  
4 infrequent, would be of greatest magnitude in wetter water years when effects on migration  
5 conditions would be less critical, and therefore are not expected to have biologically meaningful  
6 negative effects on migration conditions.

7 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
8 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
9 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
10 There would be no differences (<5%) in mean monthly water temperature between Existing  
11 Conditions and H3 in all months but October, in which temperatures under H3 would be 6% greater  
12 than those under Existing Conditions.

### 13 **Adults**

14 Flows during the adult migration period (September through March) (Appendix 11C, *CALSIM II*  
15 *Model Results utilized in the Fish Analysis*) would be as described for that portion of the juvenile  
16 migration period immediately above with the addition of September. Effects of H3 in September  
17 consist of substantial increases in mean monthly flow in wet (39%) and above normal (55%) years,  
18 small decreases in below normal (-11%) and dry years (to -14%), and negligible effects in critical  
19 years. These effects would not alter the conclusion of no biologically meaningful negative effects for  
20 the entire migration period of September through March.

21 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
22 during the September through March steelhead adult upstream migration period (Appendix 11D,  
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
25 Existing Conditions and H3 in all months except September and October, in which temperatures  
26 under H3 would be 6% greater than those under Existing Conditions.

### 27 **Kelts**

28 Effects of H3 on flows during the kelt migration period of March and April consist primarily of  
29 negligible effects (<5%), with infrequent, small increases (to 6%) and a single decrease in flow  
30 (-10%) during March in below normal water years that would not have biologically meaningful  
31 effects on migration conditions. These results indicate that effects of H3 on flows would not affect  
32 kelt migration in the Sacramento River at Red Bluff.

33 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
34 during the March through April steelhead kelt downstream migration period (Appendix 11D,  
35 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
36 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
37 Existing Conditions and H3 in any month or water year type throughout the period.

38 Overall in the Sacramento River, the effects of H3 on flows would not affect juvenile, adult, or kelt  
39 steelhead migration.

### 40 **Clear Creek**

41 No water temperature modeling was conducted in Clear Creek.

1 *Juveniles*

2 Flows in Clear Creek were evaluated for the juvenile migration period (October through May)  
3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Effects of H3 compared to  
4 Existing Conditions consist primarily of negligible effects (<5%) for October through May or small  
5 increases (to 10%) in flow and a single, small decrease (-6% during October in critical years) in  
6 mean monthly flow that would not have biologically meaningful effects on migration conditions,  
7 with the exception of more substantial increases in mean monthly flows during January through  
8 March in wet years (to 54%) which would have beneficial effects on migration conditions. As  
9 discussed for effects of H3 on rearing conditions in Clear Creek above, no water temperature  
10 modeling was conducted in Clear Creek.

11 *Adults*

12 Effects of H3 on flows in Clear Creek during the adult migration period (September through March)  
13 would be as described for that portion of the juvenile migration period immediately above with the  
14 addition of September. Effects of H3 in September consist of negligible effects for all water year  
15 types except for a decrease in mean monthly flow in critical years of -28%. Based on the limited  
16 occurrence of this flow reduction, overall effects of H3 on flows would not have biologically  
17 meaningful effects on adult migration conditions. No water temperature modeling was conducted in  
18 Clear Creek.

19 *Kelts*

20 Effects of H3 on flows during the kelt migration period of March and April consist of negligible  
21 effects (<5%) or infrequent, small to moderate increases in mean monthly flow (to 29%) that would  
22 not affect migration conditions.

23 Overall in Clear Creek, the effects of H3 on flows would not affect juvenile, adult, or kelt steelhead  
24 migration.

25 ***Feather River***

26 *Juveniles*

27 Flows in the Feather River above the Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results*  
28 *utilized in the Fish Analysis*) were evaluated for the juvenile migration period (October through  
29 May). Effects of H3 compared to Existing Conditions consist of primarily increases in mean monthly  
30 flow for most water years during October (7% to 33%), critical years during January (18%), wet  
31 years during February (31%), wetter water years during March (12% and 22%), and drier water  
32 years during April (18% to 58%). Effects of H3 consist primarily of decreases in mean monthly flow  
33 during October and November in wet (to -27%) and below normal years (-9%), most water years in  
34 December (-38% in wet years, to -7% in drier water years), most water years during January and  
35 February (to -46%, with maximum reduction in below normal years), and another substantial  
36 reduction (-53%) during March in below normal years. Overall, the decreases in flows during drier  
37 water year types for a substantial portion of the juvenile migration period would have biologically  
38 meaningful effects on juvenile migration for this location.

39 Flows in the Feather River at the confluence with the Sacramento River were evaluated for the  
40 juvenile migration period (October through May) (Appendix 11C, *CALSIM II Model Results utilized in*  
41 *the Fish Analysis*). Effects of H3 compared to Existing Conditions consist of primarily increases in

1 mean monthly flow during October (6% to 30%), during January through March in wetter water  
2 years (7% to 20%), and during April and May in drier water years (to 18%). There would be  
3 negligible effects (<5%) or decreases in mean monthly flow during November and December in wet  
4 years (to -20%), during January through March in below normal years (to -20%), and during May in  
5 wet years (-26%). Effects in drier water years would be most critical for migration conditions and  
6 would include negligible effects and relatively small increases (to 18%) or decreases (to -20%) in  
7 flow with no persistent trend throughout the migration period with the exception of small to  
8 moderate reductions during most months in below normal water years that would have negative  
9 effects on juvenile migration conditions at this location for that specific water year type.

10 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
11 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
13 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
14 Existing Conditions and H3 in all months except November and December, in which temperatures  
15 under H3 would be 5% greater than temperatures under Existing Conditions.

#### 16 *Adults*

17 Effects of H3 on flows in the Feather River above the Thermalito Afterbay during the adult migration  
18 period (September through March) would be as described for that portion of the juvenile migration  
19 period immediately above with the addition of September. Effects of H3 in September consist of  
20 substantial increases in mean monthly flow during wet (209%), above normal (128%) and critical  
21 (15%) years, and decreases during below normal (-27%) and dry (-46%) years. The substantial  
22 reductions in flows during drier water years would have biologically meaningful effects on  
23 migration conditions during September through March. Increases in flow in wet years are  
24 substantial (128 to 208%) and effects on migration would be positive. Effects of H3 on water  
25 temperatures were evaluated for adult migration conditions.

26 Effects of H3 on flows in the Feather River at the confluence during the adult migration period  
27 (September through March) would be as described for that portion of the juvenile migration period  
28 immediately above with the addition of September. Effects of H3 in September consist of variable  
29 effects depending on water year type with increases in mean monthly flow during wet (108%),  
30 above normal (68%), and critical (12%) years, and decreases during below normal (-18%) and dry  
31 (-28%) years. Effects of these substantial increases on flows in wetter water years (108%, 68%)  
32 would be beneficial. Effects of the reductions in flows for some drier water years would contribute  
33 incremental negative effects for the adult migration period and would have negative effects on  
34 migration condition in below normal water years.

35 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
36 were evaluated during the September through March steelhead adult upstream migration period  
37 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
38 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
39 temperature between Existing Conditions and H3 in all months except November and December, in  
40 which temperatures under H3 would be 5% greater than temperatures under Existing Conditions.

41 These results indicate the effects of H3 on water temperatures in the Feather River would have  
42 negative effects on juvenile and adult migration conditions that could affect survival.

1 **Kelts**

2 Effects of H3 on flows during the kelt migration period of March and April consist of primarily  
3 negligible effects (<5%) or increases in mean monthly flow (to 58%) with the exception of a single  
4 decrease in flow during March in below normal years (-53%), that would occur following equally  
5 substantial flow reductions in below normal years during January and February. This negative effect  
6 would be partially offset by a substantial increase in flow during April in below normal years (43%)  
7 but could substantially affect migration conditions for the first half of the relatively short migration  
8 period for that water year type. Overall this effect is not expected to have biologically meaningful  
9 negative effects on kelt migration success. Effects of H3 on flows during the kelt migration period of  
10 March and April consist of primarily negligible effects (<5%) and increases in mean monthly flow  
11 (to 13%) with the exception of a single, moderate decrease (-20%) in below normal years that  
12 would not have biologically meaningful effects on kelt migration conditions.

13 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
14 were evaluated during the March through April steelhead kelt downstream migration period  
15 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
16 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
17 temperature between Existing Conditions and H3 in any month or water year type throughout the  
18 period.

19 Overall in the Feather River, the effect of H3 on flows would consist of persistent and/or substantial  
20 reductions in flows during drier water years, and increased exposure to critical water temperatures,  
21 that would affect juvenile and adult migration conditions, particularly in drier water years, and  
22 would generally not affect kelt migration.

23 **American River**

24 **Juveniles**

25 Flows in the American River at the confluence with the Sacramento River were evaluated for the  
26 juvenile migration period (October through May) (Appendix 11C, *CALSIM II Model Results utilized in*  
27 *the Fish Analysis*). Effects of H3 compared to Existing Conditions consist of primarily increases in  
28 mean monthly flow during October (to 26%), wetter water years during January (to 25%), and all  
29 but critical years during February and March (to 27%). There would be reductions in flow for  
30 most/all water year types during November (to -33%), December (to -25%), drier water years  
31 during January (to -19%), critical years during February and March (to -15%), and all but dry years  
32 during May (to -31%). Flow reductions during most of the migration period in drier water year  
33 types would have biologically meaningful effects on juvenile migration.

34 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
35 River were evaluated during the October through May juvenile steelhead migration period  
36 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
37 *utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 5% to 11%  
38 lower than those under Existing Conditions in all months during the period except December and  
39 April, in which there would be no difference in water temperatures between Existing Conditions and  
40 H3.

1 **Adults**

2 Effects of H3 on flows in the American River during the adult migration period (September through  
3 March) would be as described for that portion of the juvenile migration period immediately above  
4 with the addition of September. Effects of H3 in September consist of substantial decreases in mean  
5 monthly flow during all water year types ranging from -25% to -33%. This combined with the  
6 conclusions for the rest of the migration period described above as part of the juvenile migration  
7 period indicates that effects of H3 on flow reductions during most of the migration period in drier  
8 water year types would have biologically meaningful effects on adult migration. Effects of H3 on  
9 water temperatures were evaluated for adult migration conditions.

10 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
11 River were evaluated during the September through March steelhead adult upstream migration  
12 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
13 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 5% to  
14 11% lower than those under Existing Conditions in all months during the period except December,  
15 in which there would be no difference in water temperatures between Existing Conditions and H3.

16 **Kelts**

17 Effects of H3 on flows during the kelt migration period of March and April consist primarily of  
18 relatively small increases (to 16%) and decreases (to -9%) in flow that would tend to balance out  
19 effects during the kelt migration period and would not result in biologically meaningful negative  
20 effects.

21 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
22 River were evaluated during the March and April steelhead kelt downstream migration period  
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
24 *utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 5% higher than  
25 those under Existing Conditions in March but temperatures would be similar between Existing  
26 Conditions and H3 during April.

27 Overall in the American River, the impacts of H3 on flows would affect juvenile and adult migration  
28 conditions and would negatively affect kelt migration conditions.

29 **Stanislaus River**

30 **Juveniles**

31 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
32 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H3 would be 6% to 16% lower  
34 than flows under Existing Conditions depending on month except during January, in which there  
35 would be no difference.

36 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
37 River were evaluated during the October through May steelhead juvenile downstream migration  
38 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
39 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 6%  
40 higher than those under Existing Conditions in all months during the period except October, in  
41 which temperature would be similar between Existing Conditions and H3.

1 **Adults**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
3 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H3 would be 6% to 16% lower  
5 than flows under Existing Conditions depending on month, except during January, in which there  
6 would be no differences.

7 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
8 River were evaluated during the September through March steelhead adult upstream migration  
9 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
10 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 6%  
11 higher than those under Existing Conditions in all months during the period except October, in  
12 which temperature would be similar between Existing Conditions and H3.

13 **Kelt**

14 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
15 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
16 *Results utilized in the Fish Analysis*). Mean monthly flows under H3 would be 8% to 11% lower than  
17 flows under Existing Conditions during March and April, respectively.

18 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
19 River were evaluated during the March and April steelhead kelt downstream migration period  
20 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
21 *utilized in the Fish Analysis*). Mean monthly water temperatures under H3 would be 6% higher than  
22 those under Existing Conditions during March and April.

23 **San Joaquin River**

24 Water temperature modeling was not conducted in the San Joaquin River.

25 **Juveniles**

26 Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead  
27 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
28 *Analysis*). Mean monthly flows under H3 would 5% greater than flows under Existing Conditions  
29 during January, and similar in the remaining 7 months of the period.

30 **Adults**

31 Flows in the San Joaquin River at Vernalis were evaluated for the September through March  
32 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
33 *Fish Analysis*). Mean monthly flows under H3 would 5% greater than flows under Existing  
34 Conditions during January, 8% lower during September, and similar in the remaining 5 months of  
35 the period.

36 **Kelt**

37 Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt  
38 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
39 Mean monthly flows under H3 similar to flows under Existing Conditions in both March and April.

1 **Mokelumne River**

2 Water temperature modeling was not conducted in the Mokelumne River.

3 *Juveniles*

4 Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead  
5 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Mean monthly flows under H3 would be similar to flows under Existing Conditions during  
7 October and March, 8% to 12% lower than flows under Existing Conditions during November, April,  
8 and May, and 12% to 14% higher than flows under Existing Conditions during December through  
9 February.

10 *Adults*

11 Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead  
12 adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
13 *Analysis*). Mean monthly flows under H3 would be similar to flows under Existing Conditions during  
14 October and March, 9% to 27% lower than flows under Existing Conditions during September and  
15 November, and 12% to 14% higher than flows under Existing Conditions during December through  
16 February.

17 *Kelt*

18 Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt  
19 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
20 Mean monthly flows under H3 would be similar to flows under Existing Conditions during March  
21 and 8% lower during April.

22 **H1/LOS**

23 **Sacramento River**

24 *Juveniles*

25 Flows under H1 in the Sacramento River upstream of Red Bluff during the October through May  
26 juvenile steelhead migration period would generally be similar to flows under H3, except during  
27 November, in which flows would be up to 12% lower depending on water year type (Appendix 11C,  
28 *CALSIM II Model Results utilized in the Fish Analysis*). This reduction would not occur at a high  
29 enough frequency to have a meaningful effect on juvenile steelhead migration habitat.

30 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
31 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
32 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
33 There would be no differences (<5%) in mean monthly water temperature between Existing  
34 Conditions and H1 in all months but October, in which temperatures under H1 would be 5% greater  
35 than those under Existing Conditions.

36 Overall, results for H1 would be similar to those for H3.

1       **Adults**

2       Flows under H1 in the Sacramento River upstream of Red Bluff during the September through  
3       March adult steelhead migration period would generally be similar to flows under H3, except during  
4       November, in which flows would be up to 12% lower depending on water year type (Appendix 11C,  
5       *CALSIM II Model Results utilized in the Fish Analysis*). This reduction would not occur at a high  
6       enough frequency to have a meaningful effect on juvenile steelhead migration habitat.

7       Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
8       during the September through March steelhead adult upstream migration period (Appendix 11D,  
9       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
10       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
11       Existing Conditions and H1 in all months except September and October, in which temperatures  
12       under H1 would be 5% greater than those under Existing Conditions.

13       Overall results for H1 would be similar to those for H3.

14       **Kelts**

15       Flows under H1 in the Sacramento River upstream of Red Bluff during the March through April adult  
16       steelhead migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
17       *Model Results utilized in the Fish Analysis*).

18       Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
19       during the March through April steelhead kelt downstream migration period (Appendix 11D,  
20       *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
21       *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
22       Existing Conditions and H1 in any month or water year type throughout the period.

23       Overall results for H1 would be similar to those for H3.

24       **Clear Creek**

25       No water temperature modeling was conducted in Clear Creek.

26       **Juveniles**

27       Flows under H1 in Clear Creek at Whiskeytown during the October through May juvenile migration  
28       period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
29       *in the Fish Analysis*). Overall results for H1 would be similar to those for H3.

30       **Adults**

31       Flows under H1 in Clear Creek at Whiskeytown during the September through March adult  
32       migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
33       *Results utilized in the Fish Analysis*). Overall results for H1 would be similar to those for H3.

34       **Kelts**

35       Flows under H1 in Clear Creek at Whiskeytown during the March through April kelt migration  
36       period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
37       *in the Fish Analysis*). Overall results for H1 would be similar to those for H3.

1 **Feather River**

2 *Juveniles*

3 Flows under H1 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
4 River during the October through May juvenile migration period would generally be similar to or  
5 greater than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
7 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
8 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
9 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
10 Existing Conditions and H1 in all months except December, in which temperatures under H1 would  
11 be 5% greater than temperatures under Existing Conditions.

12 Overall results for H1 would be similar to those for H3.

13 *Adults*

14 Flows under H1 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
15 River during the September through March adult migration period would generally be similar to or  
16 greater than flows under H3, except during September, in which flows would be up to 83% lower  
17 depending on water year type and location (Appendix 11C, *CALSIM II Model Results utilized in the*  
18 *Fish Analysis*). Although large, these flow reductions would not have biologically meaningful effects  
19 because they occur in only one of seven months.

20 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
21 were evaluated during the September through March steelhead adult upstream migration period  
22 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
23 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
24 temperature between Existing Conditions and H1 in all months except September and December, in  
25 which temperatures under H1 would be 5% greater than temperatures under Existing Conditions.

26 Overall results for H1 would be similar to those for H3.

27 *Kelts*

28 Flows under H1 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
29 River during the March through April kelt migration period would generally be similar to or greater  
30 than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
32 were evaluated during the March through April steelhead kelt downstream migration period  
33 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
34 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
35 temperature between Existing Conditions and H1 in any month or water year type throughout the  
36 period.

37 Overall results for H1 would be similar to those for H3.

1 **American River**

2 *Juveniles*

3 Flows under H1 in the American River at the confluence with the Sacramento River during the  
4 October through May juvenile migration period would generally be similar to flows under H3 with  
5 few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
7 River were evaluated during the October through May juvenile steelhead migration period  
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
9 *utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 5% to 10% lower  
10 than those under Existing Conditions in all months during the period except April, in which there  
11 would be no difference in water temperatures between Existing Conditions and H1.

12 Overall results for H1 would be similar to those for H3.

13 *Adults*

14 Flows under H1 in the American River at the confluence with the Sacramento River during the  
15 September through March adult migration period would generally be similar to flows under H3 with  
16 few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
18 River were evaluated during the September through March steelhead adult upstream migration  
19 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
20 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 5% to  
21 10% lower than those under Existing Conditions in all months during the period.

22 Overall results for H1 would be similar to those for H3.

23 *Kelts*

24 Flows under H1 in the American River at the confluence with the Sacramento River during the  
25 March through April kelt migration period would generally be similar to flows under H3 with few  
26 exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
28 River were evaluated during the March and April steelhead kelt downstream migration period  
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
30 *utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 5% higher than  
31 those under Existing Conditions in March but temperatures would be similar between Existing  
32 Conditions and H1 during April.

33 Overall results for H1 would be similar to those for H3.

34 **Stanislaus River**

35 *Juveniles*

36 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
37 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*  
38 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H1 would be 6% to 16% lower

1 than flows under Existing Conditions depending on month except during January, in which there  
2 would be no difference.

3 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
4 River were evaluated during the October through May steelhead juvenile downstream migration  
5 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
6 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 6%  
7 higher than those under Existing Conditions in all months during the period except October, in  
8 which temperature would be similar between Existing Conditions and H1.

#### 9 *Adults*

10 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
11 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H1 would be 6% to 16% lower  
13 than flows under Existing Conditions depending on month, except during January, in which there  
14 would be no differences.

15 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
16 River were evaluated during the September through March steelhead adult upstream migration  
17 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
18 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 6%  
19 higher than those under Existing Conditions in all months during the period except October, in  
20 which temperature would be similar between Existing Conditions and H1.

#### 21 *Kelt*

22 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
23 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
24 *Results utilized in the Fish Analysis*). Mean monthly flows under H1 would be 8% to 11% lower than  
25 flows under Existing Conditions during March and April, respectively.

26 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
27 River were evaluated during the March and April steelhead kelt downstream migration period  
28 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
29 *utilized in the Fish Analysis*). Mean monthly water temperatures under H1 would be 6% higher than  
30 those under Existing Conditions during March and April.

#### 31 ***San Joaquin River***

32 Water temperature modeling was not conducted in the San Joaquin River.

#### 33 *Juveniles*

34 Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead  
35 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
36 *Analysis*). Mean monthly flows under H1 would 5% greater than flows under Existing Conditions  
37 during January, 5% lower during October, and similar in the remaining 6 months of the period.

1 **Adults**

2 Flows in the San Joaquin River at Vernalis were evaluated for the September through March  
3 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
4 *Fish Analysis*). Mean monthly flows under H1 would be 5% greater than flows under Existing  
5 Conditions during January, 8% lower during September, and similar in the remaining 5 months of  
6 the period.

7 **Kelt**

8 Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt  
9 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
10 Mean monthly flows under H1 similar to flows under Existing Conditions in both March and April.

11 **Mokelumne River**

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **Juveniles**

14 Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead  
15 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
16 *Analysis*). Mean monthly flows under H1 would be similar to flows under Existing Conditions during  
17 October and March, 8% to 12% lower than flows under Existing Conditions during November, April,  
18 and May, and 12% to 14% higher than flows under Existing Conditions during December through  
19 February.

20 **Adults**

21 Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead  
22 adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
23 *Analysis*). Mean monthly flows under H1 would be similar to flows under Existing Conditions during  
24 October and March, 10% to 27% lower than flows under Existing Conditions during September and  
25 November, and 12% to 14% higher than flows under Existing Conditions during December through  
26 February.

27 **Kelt**

28 Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt  
29 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
30 Mean monthly flows under H1 would be similar to flows under Existing Conditions during March  
31 and 8% lower during April.

32 **H4/HOS**

33 **Sacramento River**

34 **Juveniles**

35 Flows under H4 in the Sacramento River upstream of Red Bluff during the October through May  
36 juvenile steelhead migration period would generally be similar to flows under H3 (Appendix 11C,  
37 *CALSIM II Model Results utilized in the Fish Analysis*). \

1 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
2 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*  
3 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).  
4 There would be no differences (<5%) in mean monthly water temperature between Existing  
5 Conditions and H4 in all months but October, in which temperatures under H4 would be 5% greater  
6 than those under Existing Conditions.

7 Overall, results for H4 would be similar to those for H3.

#### 8 *Adults*

9 Flows under H4 in the Sacramento River upstream of Red Bluff during the September through  
10 March adult steelhead migration period would generally be similar to flows under H3 (Appendix  
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
13 during the September through March steelhead adult upstream migration period (Appendix 11D,  
14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
16 Existing Conditions and H4 in all months except October, in which temperatures under H4 would be  
17 5% greater than those under Existing Conditions.

18 Overall results for H4 would be similar to those for H3.

#### 19 *Kelts*

20 Flows under H4 in the Sacramento River upstream of Red Bluff during the March through April adult  
21 steelhead migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II*  
22 *Model Results utilized in the Fish Analysis*).

23 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated  
24 during the March through April steelhead kelt downstream migration period (Appendix 11D,  
25 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
26 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
27 Existing Conditions and H4 in any month or water year type throughout the period.

28 Overall results for H4 would be similar to those for H3.

#### 29 **Clear Creek**

30 No water temperature modeling was conducted in Clear Creek.

#### 31 *Juveniles*

32 Flows under H4 in Clear Creek at Whiskeytown during the October through May juvenile migration  
33 period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
34 *in the Fish Analysis*). Overall results for H4 would be similar to those for H3.

#### 35 *Adults*

36 Flows under H4 in Clear Creek at Whiskeytown during the September through March adult  
37 migration period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
38 *Results utilized in the Fish Analysis*). Overall results for H4 would be similar to those for H3.

1 **Kelts**

2 Flows under H4 in Clear Creek at Whiskeytown during the March through April kelt migration  
3 period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized*  
4 *in the Fish Analysis*). Overall results for H4 would be similar to those for H3.

5 **Feather River**

6 **Juveniles**

7 Flows under H4 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
8 River during the October through May juvenile migration period would generally be similar to or  
9 greater than flows under H3, except during October, in which flows would be up to 27% lower  
10 depending on water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
11 These flow reductions would not cause biologically meaningful effects on juvenile steelhead  
12 migration conditions because they occur during only one of eight months during the period.

13 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
14 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,  
15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
17 Existing Conditions and H4 in all months except October through December, in which temperatures  
18 under H4 would be 5% greater than temperatures under Existing Conditions.

19 Overall results for H4 would be similar to those for H3.

20 **Adults**

21 Flows under H4 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
22 River during the September through March adult migration period would generally be similar to  
23 flows under H3, except during September and October, in which flows would be up to 32% lower  
24 depending on water year type and location (Appendix 11C, *CALSIM II Model Results utilized in the*  
25 *Fish Analysis*). These flow reductions would be high enough and would occur at a high enough  
26 frequency to have biologically meaningful effects on adult migration conditions.

27 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
28 were evaluated during the September through March steelhead adult upstream migration period  
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
30 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
31 temperature between Existing Conditions and H4 in all months except October through December,  
32 in which temperatures under H4 would be 5% greater than temperatures under Existing Conditions.

33 Overall results for H4 would be worse for adult migration conditions than those for H3.

34 **Kelts**

35 Flows under H4 in the Feather River at Thermalito Afterbay and the confluence with the Sacramento  
36 River during the March through April kelt migration period would generally be similar to or greater  
37 than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

38 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River  
39 were evaluated during the March through April steelhead kelt downstream migration period

1 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
2 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water  
3 temperature between Existing Conditions and H4 in any month or water year type throughout the  
4 period.

5 Overall results for H4 would be similar to those for H3.

#### 6 **American River**

##### 7 *Juveniles*

8 Flows under H4 in the American River at the confluence with the Sacramento River during the  
9 October through May juvenile migration period would generally be similar to flows under H3, except  
10 during October in which flows would be up to 13% lower under H3 (Appendix 11C, *CALSIM II Model*  
11 *Results utilized in the Fish Analysis*). These reductions would not be large or frequent enough to have  
12 biologically meaningful effects on juvenile steelhead migration conditions.

13 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
14 River were evaluated during the October through May juvenile steelhead migration period  
15 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
16 *utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 5% to 11%  
17 lower than those under Existing Conditions in all months during the period except April, in which  
18 there would be no difference in water temperatures between Existing Conditions and H4.

19 Overall results for H4 would be similar to those for H3.

##### 20 *Adults*

21 Flows under H4 in the American River at the confluence with the Sacramento River during the  
22 September through March adult migration period would generally be similar to flows under H3,  
23 except during October in which flows would be up to 13% lower under H3 (Appendix 11C, *CALSIM II*  
24 *Model Results utilized in the Fish Analysis*). These reductions would not be large or frequent enough  
25 to have biologically meaningful effects on adult steelhead migration conditions.

26 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
27 River were evaluated during the September through March steelhead adult upstream migration  
28 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
29 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 5% to  
30 11% lower than those under Existing Conditions in all months during the period.

31 Overall results for H4 would be similar to those for H3.

##### 32 *Kelts*

33 Flows under H4 in the American River at the confluence with the Sacramento River during the  
34 March through April kelt migration period would generally be similar to flows under H3 (Appendix  
35 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures in the American River at the confluence with the Sacramento  
37 River were evaluated during the March and April steelhead kelt downstream migration period  
38 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
39 *utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 5% higher than

1 those under Existing Conditions in March but temperatures would be similar between Existing  
2 Conditions and H4 during April.

3 Overall results for H4 would be similar to those for H3.

#### 4 ***Stanislaus River***

##### 5 *Juveniles*

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
7 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*  
8 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H4 would be 6% to 18% lower  
9 than flows under Existing Conditions depending on month, except during January, in which there  
10 would be no difference.

11 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
12 River were evaluated during the October through May steelhead juvenile downstream migration  
13 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
14 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 6%  
15 higher than those under Existing Conditions in all months during the period except October, in  
16 which temperature would be similar between Existing Conditions and H4.

##### 17 *Adults*

18 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
19 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*  
20 *Model Results utilized in the Fish Analysis*). Mean monthly flows under H4 would be 6% to 16% lower  
21 than flows under Existing Conditions depending on month, except during January, in which there  
22 would be no differences.

23 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
24 River were evaluated during the September through March steelhead adult upstream migration  
25 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*  
26 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 6%  
27 higher than those under Existing Conditions in all months during the period except October, in  
28 which temperature would be similar between Existing Conditions and H4.

##### 29 *Kelt*

30 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the  
31 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*  
32 *Results utilized in the Fish Analysis*). Mean monthly flows under H4 would be 8% to 11% lower than  
33 flows under Existing Conditions during March and April, respectively.

34 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin  
35 River were evaluated during the March and April steelhead kelt downstream migration period  
36 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*  
37 *utilized in the Fish Analysis*). Mean monthly water temperatures under H4 would be 6% higher than  
38 those under Existing Conditions during March and April.

1 **San Joaquin River**

2 Water temperature modeling was not conducted in the San Joaquin River.

3 *Juveniles*

4 Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead  
5 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
6 *Analysis*). Mean monthly flows under H4 would be 6% greater than flows under Existing Conditions  
7 during January and similar in the remaining 7 months of the period.

8 *Adults*

9 Flows in the San Joaquin River at Vernalis were evaluated for the September through March  
10 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*  
11 *Fish Analysis*). Mean monthly flows under H4 would be 6% greater than flows under Existing  
12 Conditions during January, 8% lower during September, and similar in the remaining 5 months of  
13 the period.

14 *Kelt*

15 Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt  
16 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
17 Mean monthly flows under H4 similar to flows under Existing Conditions in both March and April.

18 **Mokelumne River**

19 Water temperature modeling was not conducted in the Mokelumne River.

20 *Juveniles*

21 Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead  
22 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
23 *Analysis*). Mean monthly flows under H4 would be similar to flows under Existing Conditions during  
24 October and March, 8% to 12% lower than flows under Existing Conditions during November, April,  
25 and May, and 12% to 14% higher than flows under Existing Conditions during December through  
26 February.

27 *Adults*

28 Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead  
29 adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
30 *Analysis*). Mean monthly flows under H4 would be similar to flows under Existing Conditions during  
31 October and March, 10% to 27% lower than flows under Existing Conditions during September and  
32 November, and 12% to 14% higher than flows under Existing Conditions during December through  
33 February.

34 *Kelt*

35 Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt  
36 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
37 Mean monthly flows under H4 would be similar to flows under Existing Conditions during March  
38 and 8% lower during April.

1 **Through-Delta**

2 Based on DPM results for Chinook salmon, steelhead survival would not be expected to decrease  
3 more than 1%. Assuming similar effects on steelhead, Alternative 4 would have a minimal effect on  
4 steelhead migration success through the Delta. Therefore the impact to juvenile steelhead migration  
5 through the Delta would be negligible.

6 The proportion of Sacramento River water in the Delta under Alternative 4 Scenario H3 would be  
7 similar to NAA (<10% difference) during the entire adult steelhead upstream migration, except in  
8 March when the proportion of Sacramento River flows would be reduced by 10%. The reduction in  
9 olfactory cues in March may negatively affect adult steelhead migration conditions, however this  
10 month falls outside the peak migration season for this species, thus limiting its potential impact.  
11 Conditions between all flow scenarios under Alternative 4 (e.g., Scenarios H1 and H3) would be  
12 similar; there would only be small changes in olfactory cues for migrating adult salmon. Rio Vista  
13 flows under Scenario H3 would also be similar or improved compared to Alternative 1A for all the  
14 months of the adult steelhead upstream and kelt downstream migrations, except October. Flows at  
15 Rio Vista under Scenarios H1 and H4 are similar to conditions under Scenario H3 in all months of  
16 the steelhead migration period, except in September when flows under Scenario H1 would be very  
17 substantially reduced. Due to the overall similarity in olfactory cues and Rio Vista flows between  
18 Alternative 1A and Alternative 4 during the entire adult and kelt migration periods, effects on  
19 migration success would be expected to be similar to Alternative 1A. Olfactory cues and flows in the  
20 San Joaquin River basin would be improved or similar to Alternative 1A and Existing Conditions.  
21 Overall, the impact to steelhead adult and kelt migration under Alternative 4 is considered  
22 negligible.

23 **Summary of CEQA Conclusion**

24 Collectively, the results of the Impact AQUA-96 CEQA analysis indicate the difference between the  
25 CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
26 alternative could substantially interfere with the movement of fish, contrary to the NEPA conclusion  
27 set forth above. Alternative 4 would have negative effects on juvenile and adult migration conditions  
28 in drier water years in the Feather River and the American River, and increased occurrence of multi-  
29 year critical temperature exceedances would contribute to negative effects in the Feather River.  
30 Reduced migration conditions would delay or eliminate successful migration necessary to complete  
31 the steelhead life cycle. Alternative 4 would not affect migration conditions for steelhead in the  
32 Sacramento River and in Clear Creek. Water temperatures and exceedances of NMFS thresholds  
33 where applicable, would be greater in the Feather, American, and Stanislaus Rivers under  
34 Alternative 4 relative to the CEQA baseline. There would be no effects on through-Delta migration  
35 conditions because changes in juvenile survival and adult olfactory cues would be negligible.

36 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
37 change, future water demands, and implementation of the alternative. The analysis described above  
38 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
39 alternative from those of sea level rise, climate change and future water demands using the model  
40 simulation results presented in this chapter. However, the increment of change attributable to the  
41 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
42 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
43 implementation period, which does include future sea level rise, climate change, and water  
44 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
4 term implementation period and H3 indicates that flows in the locations and during the months  
5 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
6 indicates that the differences between Existing Conditions and Alternative 4 found above would  
7 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
8 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
9 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
10 impact on migration habitat for steelhead. This impact is found to be less than significant and no  
11 mitigation is required.

### 12 **Restoration Measures (CM2, CM4–CM7, and CM10)**

13 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
14 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
15 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
16 restoration measures described for steelhead under Alternative 1A (Impacts AQUA-97 through  
17 AQUA-99) also appropriately characterize effects under Alternative 4.

18 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 19 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

#### 20 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

#### 21 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

22 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
23 on steelhead are the same as those described under Alternative 1A (Impacts AQUA-97 through  
24 AQUA-99). The effects would not be adverse, and would generally be beneficial. Specifically for  
25 AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia and  
26 pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

27 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or  
28 less than significant, and no mitigation is required.

### 29 **Other Conservation Measures (CM12–CM19 and CM21)**

30 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
31 differences in other conservation-related fish effects are anticipated anywhere in the affected  
32 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
33 effects of other conservation measures described for steelhead under Alternative 1A (Impacts  
34 AQUA-100 through AQUA-108) also appropriately characterize effects under Alternative 4.

35 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 36 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

#### 37 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

1 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

2 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

3 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

4 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

5 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

6 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

7 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**  
8 **(CM21)**

9 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms  
10 on steelhead are the same as those described under Alternative 1A (Impacts AQUA-100 through  
11 AQUA-108). The effects range from no effect, to not adverse, to beneficial.

12 *CEQA Conclusion:* The effects of the nine impact mechanisms listed above range from no impact, to  
13 less than significant, to beneficial, and no mitigation is required.

## 14 **Sacramento Splittail**

### 15 **Construction and Maintenance of CM1**

#### 16 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento** 17 **Splittail**

18 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on Sacramento  
19 splittail would be similar to those described for Alternative 1A, Impact AQUA-109, except  
20 Alternative 4 would include three intakes compared to five intakes under Alternative 1A, so the  
21 effects would be proportionally less under this alternative. This would convert about 6,360 lineal  
22 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of  
23 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of  
24 shoreline and would 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-109,  
25 environmental commitments and mitigation measures would be available to avoid and minimize  
26 potential effects, and the effect would not be adverse for Sacramento splittail.

27 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-109, the impact of the construction  
28 of the water conveyance facilities on splittail would not be significant except for construction noise  
29 associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
30 because only three intakes would be constructed rather than five. Implementation of Mitigation  
31 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
32 significant.

#### 33 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 34 **of Pile Driving and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
36 Alternative 1A.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
4           Alternative 1A.

5           **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**  
6           **Splittail**

7           **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
8           Alternative 4 would be the same as those described for Alternative 1A, Impact AQUA-110, except  
9           that only three intakes would need to be maintained under Alternative 4 rather than five under  
10          Alternative 1A. As concluded in Alternative 1A, Impact AQUA-110, the impact would not be adverse  
11          for Sacramento splittail.

12          **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance  
13          of water conveyance facilities on Sacramento splittail would be less than significant and no  
14          mitigation is required.

15          **Water Operations of CM1**

16          **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

17          ***Water Exports from SWP/CVP South Delta Facilities***

18          The salvage of splittail is considered an indicator of reproductive success more than of relative  
19          impact (Sommer et al. 1997); thus splittail salvage across EIR/EIS alternatives was predicted using a  
20          historical relationship between Yolo Bypass inundation and salvage density at CVP and SWP (*BDCP*  
21          *Effects Analysis, Appendix 5B – Entrainment; Section 5B.5.4.5.2*). When averaged across all WY types,  
22          estimated entrainment of juvenile splittail at the south Delta facilities would be 385% greater under  
23          Scenario H3 compared to NAA (Table 11-4-90). The greatest increase in total entrainment occurred  
24          in above normal water years (1,881%). These increases in predicted salvage are caused by the  
25          expected increase in overall juvenile splittail abundance resulting from additional floodplain  
26          inundation in the wetter year types. The amount of Yolo Bypass inundation was explicitly modeled  
27          only for Scenario H3 because Sacramento River flows at the Fremont Weir under the other scenarios  
28          (H1,H2, and H4), were similar to or greater than those under Scenario H3. The per capita rate of  
29          splittail entrainment, which is an index of entrainment risk of an individual splittail and is directly  
30          related to the amount of water exported, averaged across all years would be reduced 38% for  
31          juveniles (Table 11-4-91) and 52% for adults (Tables 11-4-92) compared to NAA. Adult entrainment  
32          and juvenile per capita entrainment are anticipated to be reduced in all water year types due to  
33          lower South Delta exports. Because Sacramento River and OMR flows are higher under the H4 flow  
34          scenario for Alternative 4 compared to NAA, this scenario is expected to decrease total and per  
35          capita entrainment loss at the south Delta more so than the other flow scenarios (i.e., Scenarios H1-  
36          H3).

1 **Table 11-4-90. Juvenile Sacramento Splittail Entrainment Index<sup>a</sup> (Yolo Bypass days of inundation**  
 2 **method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for**  
 3 **Alternative 4 (Scenario H3) (See BDCP Effects Analysis, Appendix 5B – Entrainment, Section**  
 4 **5B.6.1.7.1)**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
Wet	4,348,574 (453%)	4,161,915 (363%)
Above Normal	690,530 (1,509%)	699,135 (1,881%)
Below Normal	11,906 (348%)	12,338 (413%)
Dry	1,429 (50%)	1,774 (70%)
Critical	-448 (-29%)	3 (0%)
All Years	1,482,150 (474%)	1,424,440 (385%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data. Average (December–March).

5

6 **Table 11-4-91. Juvenile Sacramento Splittail Entrainment Index<sup>a</sup> (Per Capita Method) at the**  
 7 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 4**  
 8 **(Scenario H3) (See BDCP Effects Analysis, Appendix 5B – Entrainment, Section 5B.6.1.7.1)**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
Wet	-1,098,765 (-55%)	-774,445 (-46%)
Above Normal	-61,019 (-46%)	-43,187 (-38%)
Below Normal	-2,484 (-25%)	-2,166 (-22%)
Dry	-892 (-44%)	-401 (-26%)
Critical	-627 (-47%)	-369 (-34%)
All Years	-270,487 (-49%)	-168,940 (-38%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data. Average (December–March).

9

10 **Table 11-4-92. Adult Sacramento Splittail Entrainment Index<sup>a</sup> (salvage density method) at the**  
 11 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 4**  
 12 **(Scenario H3) (See BDCP Effects Analysis, Appendix 5B – Entrainment, Section 5B.6.1.7.1)**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
Wet	-2,722 (-69%)	-2,857 (-70%)
Above Normal	-3,009 (-62%)	-3,024 (-63%)
Below Normal	-1,276 (-38%)	-1,011 (-32%)
Dry	-790 (-32%)	-625 (-27%)
Critical	-735 (-22%)	-512 (-16%)
All Years	-1,843 (-53%)	-1,765 (-52%)

Shading indicates entrainment increased 10% or more.

<sup>a</sup> Estimated annual number of fish lost, based on normalized data. Average (December–March).

13

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 The north Delta intakes would be screened, and all splittail except larvae less than 10 mm long  
3 would be excluded from entrainment (*BDCP Effects Analysis – Appendix 5B Entrainment, Section*  
4 *B.6.2.4, hereby incorporated by reference*). The impact of Alternative 4 (3 intakes) is estimated to be  
5 lower compared to Alternative 1A (5 intakes), based on number of intakes. Potential impacts would  
6 be minimized by project’s adaptive management plan, including monitoring of the new screens  
7 effectiveness and corrective measures if needed.

8 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

9 The effect of implementing dual conveyance for the NBA with an alternative Sacramento River  
10 intake would be the same as described under Alternative 1A (Impact AQUA-111). There would be  
11 potential for increased predation and impingement risk associated with the alternative intake.  
12 Screens on the Barker Slough pumping plant currently exclude fish greater than 25 mm, and the  
13 alternate intake on the Sacramento River would be screened to effectively exclude splittail greater  
14 than 10 mm in length (*BDCP Effects Analysis – Appendix 5B Entrainment, Section B.6.2.4, hereby*  
15 *incorporated by reference*). Therefore, for splittail it is concluded that the effect of dual North Bay  
16 Aqueduct conveyance would not be adverse.

17 **Predation Associated with Entrainment**

18 Per-capita entrainment-related predation loss of splittail at the south Delta facilities is not expected  
19 to be greater under Alternative 4 than the NAA because predicted per capita entrainment is lower  
20 due to lower south Delta exports. The predation loss would be lowest under Scenario H4 and highest  
21 under Scenarios H1 and H3. However, because predation of entrained splittail is not currently  
22 considered to be an important driver of splittail population dynamics, this variation in the predicted  
23 impact across Alternative 4 subscenarios, is not considered to be adverse in any of them.

24 Predation at the north Delta would be increased due to the installation of the proposed water export  
25 facilities on the Sacramento River, with three intakes for Alternative 4. These losses would be offset  
26 by the reduction in entrainment and predation loss at the SWP/CVP south Delta intakes, and the  
27 increased production of juvenile splittail resulting from CM2 (Yolo Bypass Fisheries Enhancement).  
28 Further, as described for Alternative 1A, the fishery agencies concluded that the predation was not a  
29 factor currently limiting splittail abundance.

30 **NEPA Effects:** In conclusion, the effect from entrainment and predation loss under Alternative 4  
31 would not be adverse, because while predation loss of splittail would be potentially increased at the  
32 north Delta facilities, it would be offset by substantial reductions in per capita entrainment and  
33 associated predation at the south Delta facilities compared to the NAA, and increased production of  
34 juvenile splittail from the Yolo Bypass by CM2 (Yolo Bypass Fisheries Enhancement) actions.

35 **CEQA Conclusion:** Under Scenario H3 (described above as a conservative scenario relative to  
36 entrainment and entrainment-associated predation) total juvenile entrainment (based on Yolo  
37 Bypass inundation) would be 474% greater averaged across all years compared to Existing  
38 Conditions due to the expected substantially higher juvenile production under Alternative 4 from  
39 more floodplain inundation. Operational activities associated with reduced south Delta water  
40 exports would result in an overall decrease in the proportion of splittail population entrained for all  
41 water year types. For example, under Scenario H3, estimated juvenile entrainment (Per Capita  
42 method) and hence pre-screen predation losses would be 49% lower and adult entrainment and

1 pre-screen predation losses would be 53% lower than Existing Conditions. Conditions under  
2 Scenario H1 would be similar to Scenario H3. Per capita entrainment and related predation loss at  
3 the south Delta would be further reduced under Scenarios H2 and H4 compared to Existing  
4 Conditions. Entrainment of splittail would also be reduced at the NBA. The impact and conclusion  
5 for predation associated with entrainment would be the same as described above.

6 In conclusion, the impact of Alternative 4 from entrainment and predation loss would be beneficial  
7 because of improvements in overall proportional entrainment, and no mitigation is required.

### 8 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 9 **Sacramento Splittail**

10 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream  
11 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning  
12 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not  
13 inundated, spawning in side channels and channel margins would be much more critical.

14 In general, Alternative 4 would have beneficial effects on splittail spawning habitat relative to the  
15 NAA by increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be  
16 negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins  
17 Slough and the Feather River, with beneficial effects from moderate to substantial increases in mean  
18 monthly flow for some months and water year types for each location. There would be negligible  
19 negative effects on water temperatures in the Feather River and a beneficial effect from a decrease  
20 in exposure to critical high water temperatures.

### 21 **H3/ESO**

#### 22 ***Floodplain Habitat***

23 Effects of H3 on floodplain spawning habitat were evaluated for Yolo Bypass. Effects in Yolo Bypass  
24 were evaluated using a habitat suitability approach based on water depth (2 m threshold) and  
25 inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow  
26 velocity was generally very low throughout the modeled area for most conditions, with generally 80  
27 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable  
28 critical velocity for early life stages of splittail; Young and Cech 1996), and because habitat  
29 heterogeneity in the flooded Yolo Bypass is high (Sommer et al. 2004; 2005).

30 There would be three fewer 30–49 day events and one fewer in above normal years under H3 than  
31 under NAA, but four more events under H3 in below normal years, and one more event in dry and  
32 critical years categories (Table 11-4-93). There would be five fewer 50–69 day events under H3 than  
33 under NAA in wet years, one more event in above normal and below normal water years, and no  
34 difference in dry and critical years. And there would be seven, one, and one more >70 day  
35 inundation events under H3 relative to NAA in wet, above normal, and below normal water years,  
36 respectively, and no difference in dry and critical water years. These results indicate that overall  
37 project-related effects on occurrence of duration inundation events would benefit splittail spawning  
38 by increasing the occurrence of longer duration inundation events. The reduction in the frequency of  
39 50-69 day events in wet years is misleading because it is due to the extension of duration of  
40 inundation, which results in the increased frequency of >70 day inundation events. In some cases,  
41 two 50-69 day events were combined into one >70 day event as a result of their extended durations.  
42 The >70 day inundation events likely contribute disproportionately to splittail production.

1 In terms of acreage of suitable splittail habitat in Yolo Bypass, there would be substantial increases  
 2 in suitable spawning habitat acreages for H3 compared to NAA for all water year types (Table 11-4-  
 3 94). Increases range from 5 to 832 acres. For wet, above normal, and below normal water years  
 4 there would be project-related increases of 49%, 56%, and 192%, respectively. The increases in dry  
 5 and critical years (7 and 5 acres, respectively) would establish small areas of suitable spawning  
 6 habitat during these water year types compared to no suitable habitat under NAA. These results  
 7 indicate that increases in inundated acreage in each water year type would result in increased  
 8 habitat and have a beneficial effect on splittail spawning.

9 **Table 11-4-93. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**  
 10 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**  
 11 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>30-49 Days</b>		
Wet	-5	-3
Above Normal	-1	-1
Below Normal	4	4
Dry	1	1
Critical	1	1
<b>50-69 Days</b>		
Wet	-5	-5
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0
<b>≥70 Days</b>		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

12

1 **Table 11-4-94. Increase in Splittail Weighted Habitat Area (acres and percent) in Yolo Bypass from**  
 2 **Existing Biological Conditions to Alternative 4 by Water Year Type from 15 2-D and Daily CALSIM II**  
 3 **Modeling Runs**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	979 (64%)	832 (49%)
Above Normal	690 (62%)	644 (56%)
Below Normal	244 (193%)	244 (193%)
Dry	7 (NA <sup>a</sup> )	7 (NA <sup>a</sup> )
Critical	5 (NA <sup>a</sup> )	5 (NA <sup>a</sup> )

<sup>a</sup> NA percent differences could not be computed because no splittail weighted habitat occurred in the bypass for NAA and Existing Conditions in those years (dividing by 0).

4  
 5 A potential effect of Alternative 4 is changes in inundation of the Sutter Bypass as a result of  
 6 increased flow diversion at the Fremont Weir. The Fremont Weir notch with gates opened would  
 7 increase the amount Sacramento River flow diverted from the river into the bypass when the river's  
 8 flow is greater than about 14,600 cfs (Munévar pers. comm.). As much as about 6,000 cfs more flow  
 9 would be diverted from the river with the opened notch than without the notch, resulting in a 6,000  
 10 cfs decrease in Sacramento River flow at the weir. A decrease of 6,000 cfs in the river, according to  
 11 rating curves developed for the river at the Fremont Weir, could result in as much as 3 feet of  
 12 reduction in river stage (Munévar pers. comm.), although understanding of how notch flows would  
 13 affect river stage is incomplete (Kirkland pers. comm.). In any case, an analysis was conducted to  
 14 determine whether there would be effects to the Sutter Bypass. Daily average inundated surface in  
 15 the lower Sutter Bypass during December through June was estimated area for all scenarios. The  
 16 analysis predicts that there would be very little differences between NAA and H3 in daily average  
 17 inundation (Table 11-4-95). Therefore, H3 would not affect splittail spawning and rearing habitat in  
 18 the Sutter Bypass.

19 **Table 11-4-95. Differences (and Percent Change) in Daily Average (December–June) Lower Sutter**  
 20 **Bypass Inundation (acres)**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-83 (-3.5)	13 (0.6)
Above Normal	49 (3.7)	42 (3.1)
Below Normal	-37 (-11.0)	6 (2.0)
Dry	-12 (-8.7)	-3 (-2.5)
Critical	1 (5.3)	0 (0.8)
All	1 (0.1)	0 (0)

21  
 22 ***Channel Margin and Side-Channel Habitat***

23 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel  
 24 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,  
 25 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are  
 26 affected by changes in flow because greater flows cause more flooding, thereby increasing  
 27 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially  
 28 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are

1 expected to be most important to the splittail population because in years of high-flows, when most  
2 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively  
3 little production.

4 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions  
5 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the  
6 Sacramento River for the time-frame February through June. These are the most important months  
7 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from  
8 the side-channel habitats during May and June if conditions become unfavorable.

9 Differences between model scenarios for monthly average flows during February through June by  
10 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather  
11 River at the confluence.

12 Flow comparisons of H3 to Existing Conditions in the Sacramento River at Wilkins Slough (Appendix  
13 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for February through June, indicate that H3  
14 would have primarily negligible effects (<5%) or increases in monthly flow (to 39%), with the  
15 exception of a decrease in flow (-6%) during March in below normal years and a large decrease (-  
16 16%) during May in wet years when effects of flow reductions on rearing conditions would be less  
17 critical. These decreases in flow may reduce spawning success of splittail in wet water years. Flows  
18 during May and June would be up to 23% greater than flows under NAA depending on water year  
19 type. These increased flows would have beneficial effects on splittail. Modeling results also show  
20 that Sacramento splittail spawning temperature tolerances would not be exceeded in the  
21 Sacramento River under Alternative 4.

22 Flows in the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
23 *Model Results utilized in the Fish Analysis*) during February through June would follow similar  
24 patterns to those of the Sacramento River at Wilkins Slough. Flows under H3 would generally be  
25 similar to or greater than flows under NAA. Flows under H3 during April, May, and June would be up  
26 to 65% greater than flows under NAA, which is a beneficial effect to splittail.

27 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather  
28 River at the confluence with the Sacramento River, respectively, were used to investigate the  
29 potential effects of H3 on the suitability of water temperatures for splittail spawning and egg  
30 incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and egg  
31 incubation.

32 There would be no biologically meaningful difference (>5% absolute scale) between NAA and H3 in  
33 the frequency of water temperatures in the Sacramento River being within the suitable 45°F to 75°F  
34 regardless of water year type (Table 11-4-96). In the Feather River, there would be differences  
35 between NAA and H3 in temperatures below 45°F. There would be a 7% and 6% reduction in the  
36 exceedance above the 75°F threshold for above and below normal water years, respectively, but no  
37 other differences.

1 **Table 11-4-96. Difference (Percent Difference) in Percent of Days or Months<sup>a</sup> during February to**  
 2 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**  
 3 **Hamilton City and Feather River at the Confluence with the Sacramento River<sup>b</sup>**

	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>Sacramento River at Hamilton City</b>		
<i>Temperatures below 45°F</i>		
Wet	-3.5 (-75%)	0 (0%)
Above Normal	-3.9 (-84%)	0.2 (33%)
Below Normal	-4.3 (-85%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-1.5 (-73%)	0.2 (45%)
All	-3.1 (-78%)	0.1 (12%)
<i>Temperatures above 75°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<b>Feather River at Sacramento River Confluence</b>		
<i>Temperatures below 45°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<i>Temperatures above 75°F</i>		
Wet	14.6 (475%)	0 (0%)
Above Normal	10.9 (NA)	-7.3 (-40%)
Below Normal	20 (NA)	-5.7 (-22%)
Dry	27.8 (626%)	-1.1 (-3%)
Critical	25 (250%)	0 (0%)
All	19.5 (564%)	-2.2 (-9%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Days were used in the Sacramento River and months were used in the Feather River.

<sup>b</sup> Based on the modeling period of 1922 to 2003.

4  
 5 These results indicate that H3 would cause negligible effects on splittail spawning conditions in  
 6 channel margin and side-channel habitats resulting from changes in flow and water temperatures.  
 7 Effects of H3 on mean monthly flow would consist of negligible effects or increases in flow  
 8 (increases up to 23% in the Sacramento River and to 65% in the Feather River) for some months  
 9 and water year types in the spawning period that would have beneficial effects on rearing  
 10 conditions. There would be negligible or beneficial project-related effects on exceedance of critical

1 water temperatures, and a beneficial effect from a decrease (-60%) in exposure to critical high water  
2 temperatures in the Feather River.

### 3 ***Stranding Potential***

4 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,  
5 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and  
6 historical data to evaluate possible stranding effects, the following provides a narrative summary of  
7 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,  
8 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the  
9 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial  
10 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.  
11 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding  
12 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while  
13 keeping water away from other areas to reduce stranding in isolated ponds. Actions under H3 to  
14 increase the frequency of Yolo Bypass inundation would increase the frequency of potential  
15 stranding events. For splittail, an increase in inundation frequency would also increase the  
16 production of Sacramento splittail in the bypass. While total stranding losses may be greater under  
17 H3 than under NAA, the total number of splittail would be expected to be greater under H3.

18 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement  
19 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands  
20 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may  
21 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the  
22 potential improvements in habitat capacity outweighed the potential stranding problems that may  
23 exist in some years.

### 24 **H1/LOS**

#### 25 ***Floodplain Habitat***

26 Flows in the Sacramento River at Fremont Weir under H1 would generally be similar to or greater  
27 than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). As a result,  
28 no inundation analyses in the Yolo Bypass were conducted for H1. Overall, floodplain habitat  
29 conditions for splittail under H1 would be similar to or better than conditions under H3.

#### 30 ***Channel Margin and Side-Channel Habitat***

31 Flows under H1 in the Sacramento River at Wilkins Slough during February through June would be  
32 similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 There would be no biologically meaningful difference (>5% absolute scale) between NAA and H1 in  
34 the frequency of water temperatures in the Sacramento River being within the suitable 45°F to 75°F  
35 regardless of water year type (Table 11-4-97). In the Feather River, there would be differences  
36 between NAA and H1 in temperatures below 45°F. There would be a 7% increase in the exceedance  
37 above the 75°F threshold for wet and above normal water years under H1 relative to NAA, but no  
38 other differences.

1 **Table 11-4-97. Difference (Percent Difference) in Percent of Days or Months<sup>a</sup> during February to**  
 2 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**  
 3 **Hamilton City and Feather River at the Confluence with the Sacramento River<sup>b</sup>**

	EXISTING CONDITIONS vs. H1	NAA vs. H1	EXISTING CONDITIONS vs. H4	NAA vs. H4
<b>Sacramento River at Hamilton City</b>				
<b><i>Temperatures below 45°F</i></b>				
Wet	-3.5 (-75%)	0 (0%)	-3.5 (-75%)	0 (0%)
Above Normal	-4.1 (-88%)	0 (0%)	-4 (-86%)	0.1 (16%)
Below Normal	-4.3 (-85%)	0 (0%)	-4.3 (-85%)	0 (0%)
Dry	-2 (-68%)	0 (0%)	-2 (-68%)	0 (0%)
Critical	-1.5 (-73%)	0.2 (45%)	-1.6 (-78%)	0.1 (23%)
All	-3.1 (-78%)	0.1 (12%)	-3.1 (-78%)	0.1 (12%)
<b><i>Temperatures above 75°F</i></b>				
Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b>Feather River at Sacramento River Confluence</b>				
<b><i>Temperatures below 45°F</i></b>				
Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
<b><i>Temperatures above 75°F</i></b>				
Wet	22.3 (725%)	7.7 (44%)	15.4 (501%)	0.8 (5%)
Above Normal	25.5 (NA)	7.3 (40%)	10.9 (NA)	-7.3 (-40%)
Below Normal	22.9 (NA)	-2.8 (-11%)	20 (NA)	-5.7 (-22%)
Dry	28.9 (650%)	0 (0%)	31.2 (702%)	2.3 (7%)
Critical	25 (250%)	0 (0%)	25 (250%)	0 (0%)
All	24.6 (712%)	2.9 (12%)	20.5 (593%)	-1.2 (-5%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Days were used in the Sacramento River and months were used in the Feather River.

<sup>b</sup> Based on the modeling period of 1922 to 2003.

4  
 5 Overall, channel margin and side-channel habitat conditions for splittail under H1 would be similar  
 6 to or marginally worse than conditions under H3.

1       **Stranding Potential**

2       Because flows in the Yolo Bypass under H1 would generally be similar to flows under H3, stranding  
3       potential would not differ between H1 and H3. Therefore, the results for H1 would be the same as  
4       those for H3.

5       **H4/HOS**

6       **Floodplain Habitat**

7       Flows in the Sacramento River at Fremont Weir under H4 would generally be similar to or greater  
8       than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). As a result,  
9       no inundation analyses in the Yolo Bypass were conducted for H4. Overall, floodplain habitat  
10      conditions for splittail under H4 would be similar to or marginally better than conditions under H3.

11      **Channel Margin and Side-Channel Habitat**

12      Flows under H4 in the Sacramento River at Wilkins Slough during February through June would be  
13      similar to flows under H3, except during June, in which modeled flows would be up to 21% lower  
14      than under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These  
15      reductions are not expected to affect splittail habitat in a biologically meaningful way because they  
16      occur in only one of five months of splittail presence.

17      There would be no biologically meaningful difference (>5% absolute scale) between NAA and H1 in  
18      the frequency of water temperatures in the Sacramento River being within the suitable 45°F to 75°F  
19      regardless of water year type (Table 11-4-97). In the Feather River, there would be differences  
20      between NAA and H1 in temperatures below 45°F. There would be a 7% and 6% reduction in the  
21      exceedance above the 75°F threshold for above and below normal water years under H4 relative to  
22      NAA, but no other differences.

23      Overall, channel margin and side-channel habitat conditions for splittail under H4 would be similar  
24      to or marginally better than conditions under H3.

25      **Stranding Potential**

26      Because flows in the Yolo Bypass under H4 would generally be similar to flows under H3, stranding  
27      potential would not differ between H4 and H3. Therefore, the results for H4 would be the same as  
28      those for H3.

29      **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
30      substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
31      of egg mortality. The effects of H3 on splittail spawning habitat are largely beneficial due to  
32      increased inundation in the Yolo Bypass, negligible effects and beneficial effects in some months on  
33      channel margin and side-channel habitats in the Sacramento River at Wilkins Slough (increases in  
34      mean monthly flow to 23%) and the Feather River (increases in mean monthly flow to 65%), and  
35      negligible or beneficial effects on water temperatures in the Sacramento and Feather Rivers).

36      **CEQA Conclusion:** In general, Alternative 4 would have beneficial effects on splittail spawning  
37      habitat relative to Existing Conditions by increasing the quantity of spawning habitat in the Yolo  
38      Bypass. There would be negligible effects on channel margin and side-channel habitats in the  
39      Sacramento River at Wilkins Slough and the Feather River. There would be negative effects on water  
40      temperatures in the Feather River relative to Existing Conditions, but the benefits due to increased

1 inundation in the Yolo Bypass would outweigh the detrimental effects of increased water  
2 temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to  
3 splittail than channel margin habitat in the Feather River as evidenced by the large amount of  
4 spawning activity when inundated.

5 **H3/ESO**

6 ***Floodplain Habitat***

7 Comparisons of splittail weighted habitat area for H3 and Existing Conditions show relatively little  
8 difference between the two scenarios, with no change or relatively small increases or decreases in  
9 longer-duration inundation events for H3 compared to Existing Conditions, except for somewhat  
10 larger increases or decreases in wet water year types (Table 11-4-93). However, H3 would result in  
11 increased acreage of suitable spawning habitat compared to Existing Conditions (Table 11-4-94),  
12 with increases of between 5 and 979 acres of suitable spawning habitat depending on water year  
13 type. Increased areas for wet, above normal, and below normal water years are predicted to be 63%,  
14 62%, and 193%, respectively for H3. Comparisons for dry and critical water years indicate project-  
15 related increases of 7 and 5 acres of suitable spawning habitat, respectively, compared to 0 acres for  
16 Existing Conditions. There would generally be no or small effects (9% to 11% lower in below normal  
17 and dry years) of H3 on splittail spawning and rearing habitat in the Sutter Bypass relative to  
18 Existing Conditions (Table 11-4-95). These results indicate that H3 would have beneficial effects on  
19 splittail habitat through increasing the acreage of suitable spawning habitats by up to 193%.

20 ***Channel Margin and Side-Channel Habitat***

21 Flow comparisons of H3 to Existing Conditions for the Sacramento River at Wilkins Slough  
22 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for February through June  
23 indicate that H3 would have primarily negligible effects (<5%) or increases in mean monthly flow  
24 (to 39%), with the exception of a small decrease in flow (-6%) during March in below normal years  
25 and a moderate decrease (-16%) during May in wet years when effects of flow reductions on rearing  
26 conditions would be less critical. These decreases in flow would have little or no biologically  
27 meaningful negative effects and the increases in flow during May and June would have a beneficial  
28 effect on channel margin and side-channel habitats. Modeling results also show that Sacramento  
29 splittail spawning temperature tolerances would not be exceeded in the Sacramento River.

30 Results for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
31 *Model Results utilized in the Fish Analysis*) show variable effects of H3 depending on month and  
32 water year type. Results for February through April include mostly negligible effects (<5%) and  
33 small to moderate increases in mean monthly flow (to 20%), with the exception of a small decrease  
34 (-11%) during February, and a moderate decrease (-20%) during March, in below normal years.  
35 Effects of H3 during May and June consist of negligible (<5%) effects, and both flow increases (to  
36 59%) and decreases (to -26%), depending on water year type. Decreases in drier water years when  
37 effects of flow reductions would be more critical for rearing conditions are limited to a small  
38 reduction (-10%) during June in critical years (late in the rearing period). Based on a prevalence of  
39 negligible (<5%) or beneficial effects on flow (increases to 59%), and isolated decreases that would  
40 be of small magnitude and/or not occur at the more critical times for rearing success, these results  
41 indicate that effects of Alternative 4 on flow would not have biologically meaningful negative effects  
42 on splittail spawning conditions in channel margin and side-channel habitats in the Feather River.

1 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather  
2 River at the confluence with the Sacramento River, respectively, were used to investigate the  
3 potential effects of H3 on the suitability of water temperatures for splittail spawning and egg  
4 incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and egg  
5 incubation.

6 There would be no biologically meaningful difference (>5% absolute scale) between Existing  
7 Conditions and H3 in the frequency of water temperatures in the Sacramento River being within the  
8 suitable 45°F to 75°F regardless of water year type (Table 11-4-96). In the Feather River, there  
9 would be differences between Existing Conditions and H3 in temperatures below 45°F. There would  
10 be a 11% to 28% increases in the exceedance above the 75°F threshold under H3 relative to Existing  
11 Conditions, respectively, but no other differences.

### 12 ***Stranding Potential***

13 Because there would be little difference in flow conditions between H3 and Existing Conditions in  
14 Yolo Bypass, the project will not affect stranding potential.

### 15 **H1/LOS**

16 Because flows and water temperatures under H1 would be similar to those under H3, conclusions  
17 for H1 are similar to those under H3.

### 18 **H4/HOS**

19 Because flows and water temperatures under H4 would be similar to those under H3, conclusions  
20 for H4 are similar to those under H3.

### 21 **Summary of CEQA Conclusion**

22 Collectively, these results indicate that the impact is not significant because it would not  
23 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
24 of egg mortality. The effects of H3 on splittail spawning habitat are largely beneficial. Benefits due to  
25 increased inundation in the Yolo Bypass would outweigh increases in exceedance of critical high  
26 water temperatures in the Feather River because the Yolo Bypass is a more important spawning  
27 habitat to splittail than channel margin habitat in the Feather River as evidenced by the large  
28 amount of spawning activity when inundated.

### 29 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

#### 30 **H3/ESO**

31 In general, Alternative 4 would have beneficial effects on splittail rearing habitat relative to the NAA  
32 by increasing the quantity and quality of rearing habitat in the Yolo Bypass. There would be  
33 beneficial effects on rearing conditions in channel margin and side-channel habitats from moderate  
34 to substantial increases in mean monthly flow during most of the rearing period in the Sacramento  
35 River and the Feather River. There would be a beneficial effect from reduced exposure to critical  
36 water temperatures in the Feather River.

37 Floodplains are important rearing habitats for juvenile splittail during periods of high flows when  
38 areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated,

1 splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion  
2 applies to rearing as well as spawning habitat for splittail for H3.

3 **H1/LOS**

4 Because flows and water temperatures under H1 would be similar to those under H3, conclusions  
5 for H1 are similar to those under H3.

6 **H4/HOS**

7 Because flows and water temperatures under H4 would be similar to those under H3, conclusions  
8 for H4 are similar to those under H3.

9 **NEPA Effects:** Based on the analyses above, the effect of Alternative 4 on splittail rearing habitat is  
10 not adverse because it would not substantially reduce rearing habitat or substantially reduce the  
11 number of fish as a result of mortality.

12 **CEQA Conclusion:** In general, Alternative 4 would have beneficial effects on splittail rearing habitat  
13 relative to Existing Conditions by increasing the quantity of rearing habitat in the Yolo Bypass  
14 through increased acreage subjected to periodic inundation. There would be negligible effects on  
15 channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the  
16 Feather River, with beneficial effect due to moderate to substantial increases in mean monthly flow  
17 for some months and water year types during the rearing period. There would be negative effects on  
18 water temperatures in the Feather River relative to Existing Conditions, but the benefits due to  
19 increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water  
20 temperatures in the Feather River because the Yolo Bypass is a more important rearing habitat to  
21 splittail than channel margin habitat in the Feather River as evidenced by the large amount of  
22 rearing activity when inundated.

23 **H3/ESO**

24 As described above, floodplains are important rearing habitats for juvenile splittail during periods of  
25 high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are  
26 not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous  
27 impact discussion applies to rearing as well as spawning habitat for splittail for H3.

28 **H1/LOS**

29 Because flows and water temperatures under H1 would be similar to those under H3, conclusions  
30 for H1 are similar to those under H3.

31 **H4/HOS**

32 Because flows and water temperatures under H4 would be similar to those under H3, conclusions  
33 for H4 are similar to those under H3.

34 **Summary of CEQA Conclusion**

35 Based on the analyses above, the impact of Alternative 4 on splittail rearing habitat is not significant  
36 because it would not substantially reduce rearing habitat or substantially reduce the number of fish  
37 as a result of mortality, and no mitigation is necessary.

1 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**  
2 **Splittail**

3 **Upstream of the Delta**

4 In general, Alternative 4 would not affect migration conditions for juvenile or adult splittail in the  
5 Sacramento River or the Feather River relative to the NAA based on negligible or beneficial effects  
6 on mean monthly flow during the migration period and negligible effects on exposure to critical  
7 water temperatures in the Feather River. Adults migrate upstream primarily in December through  
8 March and juvenile migrate primarily in April through July (Moyle et al. 2004).

9 **H3/ESO**

10 The effects of H3 on splittail migration conditions would be the same as described for channel  
11 margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112  
12 above. There would be benefits to channel margin and side-channel habitat in both locations from  
13 increases in mean monthly flow, and from decreased exposure to critical high water temperatures  
14 compared to NAA.

15 **H1/LOS**

16 The effects of H1 on splittail migration conditions would be the same as described for channel  
17 margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112  
18 above. These effects would be similar to those for H3.

19 **H4/HOS**

20 The effects of H4 on splittail migration conditions would be the same as described for channel  
21 margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112  
22 above. These effects would be similar to those for H3.

23 **Through-Delta**

24 Alternative 4 would generally reduce OMR reverse flows during the period of juvenile splittail  
25 migration through the Delta under all flow scenarios. Modeled OMR flows under Alternative 4 would  
26 be reduced slightly in May under all flow scenarios (i.e., Scenarios H1-H4), but flows would still be  
27 less negative. Modeled OMR flows would be increased in June and July under Alternative 4 flow  
28 scenarios compared to baseline conditions (NAA). Based on the modeling overall negative OMR  
29 flows decrease during the splittail migration period, the effect on the species under Alternative 4  
30 would not be adverse and may provide a benefit to the species.

31 **NEPA Effects:** Therefore, the effect of Alternative 4 is not adverse because it would not substantially  
32 reduce or degrade migration habitat or substantially reduce the number of fish as a result of  
33 mortality.

34 **CEQA Conclusion:**

35 **Upstream of the Delta**

36 In general, effects of Alternative 4 would have beneficial effects on splittail migration conditions  
37 relative to Existing Conditions based on moderate to substantial increases in mean monthly flow in  
38 the Sacramento River and the Feather River. There would be a negative effect based on substantial

1 increases in exposure to critical water temperatures in the Feather River but this would be offset by  
2 the more substantial beneficial effects from increases in mean monthly flow for much of the  
3 migration period, and lack of negative effects on water temperature in the Sacramento River, which  
4 is the migration route to the main spawning and rearing area, the Yolo Bypass.

### 5 **H3/ESO**

6 Effects of H3 on splittail migration conditions are the same as described for channel margin and  
7 side-channel habitats in Impact AQUA-112.

### 8 **H1/LOS**

9 The effects of H1 on splittail migration conditions would be the same as described for channel  
10 margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112  
11 above. These effects would be similar to those for H3.

### 12 **H4/HOS**

13 The effects of H4 on splittail migration conditions would be the same as described for channel  
14 margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112  
15 above. These effects would be similar to those for H3.

### 16 **Through-Delta**

17 Average modeled OMR flows would be greater under Scenario H3 than the CEQA baseline during the  
18 majority of the juvenile splittail migration through the Delta. Conditions would be similar between  
19 Scenarios H1 and H3. OMR flow conditions under Scenario H4 would further improve migration  
20 conditions for juvenile splittail. Therefore the impact on splittail migration survival would be less  
21 than significant and may provide a benefit to the species.

### 22 **Summary of CEQA Conclusion**

23 The impact is less than significant because it would not substantially reduce suitable migration  
24 habitat or substantially reduce the number of fish as a result of mortality and no mitigation is  
25 necessary. Effects of Alternative 4 on flow would not have negative effects on the availability of  
26 channel margin and main-channel habitat, and would have a beneficial effect through increases in  
27 mean monthly flow for some months and water year types during the migration period. Benefits to  
28 flow conditions in both rivers, and lack of negative effects on water temperatures in the Sacramento  
29 River, outweigh the negative effects of substantial increases in exposure to critical water  
30 temperatures in the Feather River. This is because the Sacramento River serves as the migration  
31 route to the primary splittail spawning and rearing area, the Yolo Bypass, and migration conditions  
32 in the Feather River are less critical for regional splittail survival.

### 33 **Restoration Measures (CM2, CM4–CM7, and CM10)**

34 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
35 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
36 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
37 restoration measures described for Sacramento splittail under Alternative 1A (Impacts AQUA-115  
38 through AQUA-117) also appropriately characterize effects under Alternative 4.

1 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

2 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

3 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**  
4 **Sacramento Splittail**

5 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

6 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms  
7 on splittail are the same for Alternative 4, as those described under Alternative 1A (Impacts AQUA  
8 115-through AQUA-117). The effects would not be adverse, and generally beneficial. Specifically for  
9 AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper,  
10 ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail  
11 are uncertain.

12 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or  
13 less than significant, and no mitigation is required.

14 **Other Conservation Measures (CM12–CM19 and CM21)**

15 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
16 differences in other conservation-related fish effects are anticipated anywhere in the affected  
17 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
18 effects of other conservation measures described for Sacramento splittail under Alternative 1A  
19 (Impacts AQUA-118 through AQUA-126) also appropriately characterize effects under Alternative 4.

20 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

21 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

22 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**  
23 **Splittail (CM13)**

24 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**  
25 **(CM14)**

26 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**  
27 **(CM15)**

28 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

29 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

30 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

31 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

32 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**  
33 **Splittail (CM21)**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms  
2 on splittail are the same as those described under Alternative 1A (Impact s AQUA-118 through  
3 AQUA-126). The effects range from no effect, to not adverse, to beneficial.

4 **CEQA Conclusion:** The effects of the nine impact mechanisms listed above range from no impact, to  
5 less than significant, to beneficial, and no mitigation is required.

## 6 **Green Sturgeon**

### 7 **Construction and Maintenance of CM1**

#### 8 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

9 The potential effects of construction of the water conveyance facilities on green sturgeon would be  
10 similar to those described for Alternative 1A, Impact AQUA-127, except that Alternative 4 would  
11 include three intakes compared to five intakes under Alternative 1A, so the effects would be  
12 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing  
13 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and  
14 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
15 would require 27.3 acres of dredging. Alternative 4 would use five barge locations rather than six as  
16 under Alternative 1A so those effects would also be proportionally less. Additionally, construction  
17 and excavation at Clifton Court Forebay would be done in the dry via installation of cofferdams for  
18 isolation and dewatering of work areas. Implementation of Appendix 3B, *Environmental*  
19 *Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize  
20 adverse effects as described for Alternative 1A. Mitigation measures would also be available to avoid  
21 and minimize potential effects.

22 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-127, the effect would not be adverse  
23 for green sturgeon.

24 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-127, the impact of the construction  
25 of the water conveyance facilities on green sturgeon would not be significant except for construction  
26 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
27 because only three intakes would be constructed rather than five. Implementation of Mitigation  
28 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
29 significant.

#### 30 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 31 **of Pile Driving and Other Construction-Related Underwater Noise**

32 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
33 Alternative 1A.

#### 34 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 35 **and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
37 Alternative 1A.

**Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

**NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under Alternative 4 would be the same as those described for Alternative 1A, Impact AQUA-128, except that only three intakes would need to be maintained under Alternative 4 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-128, the impact would not be adverse for green sturgeon.

**CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-128, the impact of the maintenance of water conveyance facilities on green sturgeon would be less than significant and no mitigation is required.

**Water Operations of CM1**

**Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

**Water Exports**

The potential entrainment effects under Alternative 4 would be the same as those under Alternative 1A. Operating new north Delta intakes and dual conveyance for SWP NBA have the potential to avoid or reduce entrainment as described for Alternative 1A; there would be no adverse effect.

Scenario H3 would substantially reduce entrainment of juvenile green sturgeon at the south Delta export facilities by about 51% relative to NAA (Table 11-4-98). Entrainment loss would be reduced 57% in wetter years and by 37% in drier years under Scenario H3 compared to NAA. Compared to the Scenario H3, entrainment losses of green sturgeon would be greater under Scenario H1 and reduced under the HOS. Under all flow scenarios, however, entrainment at the south Delta facilities would be substantially reduced compared to the NAA.

**Table 11-4-98. Juvenile Green Sturgeon Entrainment Index at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 4 (Scenario H3)**

Water Year Type <sup>b</sup>	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A4 (H3)	NAA vs. A4 (H3)
Wet and Above Normal	-72 (-62%)	-59 (-57%)
Below Normal, Dry, and Critical	-23 (-47%)	-15 (-37%)
All Years	-95 (-57%)	-75 (-51%)

<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.

<sup>b</sup> Sacramento Valley water year-types.

**Predation Associated with Entrainment**

Entrainment-related predation loss of juvenile green sturgeon would not be greater under this Alternative and may be lower relative to baseline due to a reduction in entrainment loss. Conditions under Scenario H4 would likely reduce predation loss relative to Scenario H3, while conditions under Scenario H1 would likely increase predation loss slightly relative to Scenario H1. The impact and conclusion for predation risk associated with NPB structures and the north Delta intakes would be the same as described for Alternative 1A (Impact AQUA-129).

1 **NEPA Effects:** In conclusion, the effect of Alternative 4 on entrainment and associated predation of  
2 green sturgeon would not be adverse and may provide modest benefit due to reduced losses at the  
3 south Delta facilities.

4 **CEQA Conclusion:** As described above, the impact of the water operations on green sturgeon would  
5 be less than significant and no mitigation would be required.

6 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
7 **Green Sturgeon**

8 In general, Alternative 4 would not affect spawning and egg incubation habitat for green sturgeon  
9 relative to the NAA.

10 **H3/ESO**

11 **Sacramento River**

12 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
13 Bluff during the March to July spawning and egg incubation period for green sturgeon (Appendix  
14 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area  
15 available for spawning and egg incubation. Flows under H3 would always be similar to or greater  
16 than flows under NAA except for lower flows in dry years during July upstream of Red Bluff and  
17 Keswick (7% lower). Also, flows can be lower or higher in individual months of individual years  
18 These results indicate that flows in the Sacramento River would increase overall under H3.

19 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
20 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
21 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
22 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
23 NAA and H3 in any month or water year type throughout the period.

24 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was  
25 determined for each month (May through September) and year of the 82-year modeling period  
26 (Table 11-4-13). The combination of number of days and degrees above the 63°F threshold were  
27 further assigned a “level of concern”, as defined in Table 11-4-14. Differences between baselines and  
28 H3 in the highest level of concern across all months and all 82 modeled years are presented in Table  
29 11-4-99. There would be no substantial differences between NAA and H3 in the number of years  
30 with each “level of concern”.

31 **Table 11-4-99. Differences between Baseline and H3 Scenarios in the Number of Years in Which**  
32 **Water Temperature Exceedances above 63°F Are within Each Level of Concern, Sacramento River**  
33 **at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. H3	NAA vs. H3
Red	10 (250%)	1 (8%)
Orange	1 (100%)	1 (100%)
Yellow	3 (150%)	0 (0%)
None	-14 (-19%)	-2 (-3%)

34

1 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type  
 2 during May through September (Table 11-4-100). Total degree-days under H3 would be 5% to 11%  
 3 higher than under NAA during July through September and 10% to 11% lower during May and June.

4 **Table 11-4-100. Differences between Baseline and H3 Scenarios in Total Degree-Days (°F-Days) by**  
 5 **Month and Water Year Type for Water Temperature Exceedances above 63°F in the Sacramento**  
 6 **River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
May	Wet	1,065 (282%)	-137 (-9%)
	Above Normal	228 (107%)	-127 (-22%)
	Below Normal	434 (198%)	-29 (-4%)
	Dry	246 (132%)	-168 (-28%)
	Critical	454 (205%)	44 (7%)
	All	2,427 (200%)	-417 (-10%)
June	Wet	500 (130%)	-211 (-19%)
	Above Normal	66 (45%)	-163 (-43%)
	Below Normal	276 (199%)	-76 (-15%)
	Dry	514 (273%)	-20 (-3%)
	Critical	623 (155%)	73 (8%)
	All	1,979 (157%)	-397 (-11%)
July	Wet	653 (126%)	47 (4%)
	Above Normal	347 (428%)	77 (22%)
	Below Normal	591 (402%)	135 (22%)
	Dry	1,313 (466%)	385 (32%)
	Critical	1,776 (216%)	-10 (-0.4%)
	All	4,680 (253%)	634 (11%)
August	Wet	2,091 (300%)	128 (5%)
	Above Normal	830 (203%)	171 (16%)
	Below Normal	1,246 (470%)	211 (16%)
	Dry	2,063 (308%)	453 (20%)
	Critical	2,732 (184%)	113 (3%)
	All	8,962 (254%)	1,076 (9%)
September	Wet	806 (109%)	97 (7%)
	Above Normal	586 (82%)	186 (17%)
	Below Normal	1,570 (210%)	424 (22%)
	Dry	2,425 (190%)	-171 (-4%)
	Critical	1,938 (93%)	47 (1%)
	All	7,325 (132%)	583 (5%)

7

8 **Feather River**

9 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with  
 10 the Sacramento River during the February through June green sturgeon spawning and egg  
 11 incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under  
 12 H3 would be similar to or greater than flows under NAA in both locations except in below normal

1 years during March (6% to 19% lower, depending on location). These results indicate that flows in  
2 the Feather River would increase overall under H3 independent of climate change.

3 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
4 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
6 *Fish Analysis*). Mean monthly water temperatures under H3 would be 6% greater than those under  
7 NAA during February but there would be no differences (<5%) between NAA and H3 in any other  
8 month during the period.

9 Water temperature-related effects of H3 on green sturgeon spawning, egg incubation, and rearing  
10 habitat in the Feather River were evaluated by determining the percent of months during May  
11 through September in which water temperatures exceed a 64°F temperature threshold at Gridley  
12 (Table 11-4-101). Effects on spawning and egg incubation are evaluated here for May and June;  
13 effects on rearing are evaluated under Impact AQUA-131. The percent of months exceeding the  
14 threshold during May and June under H3 would be similar to or up to 27% lower than that under  
15 NAA, representing a small to moderate benefit of H3.

16 **Table 11-4-101. Differences between Baselines and H3 in Percent of Months during the 82-Year**  
17 **CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed**  
18 **the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H3</b>					
May	35 (108%)	28 (153%)	21 (213%)	15 (400%)	9 (350%)
June	5 (5%)	0 (0%)	4 (5%)	9 (13%)	12 (26%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	28 (41%)
August	0 (0%)	0 (0%)	9 (9%)	20 (25%)	35 (56%)
September	17 (25%)	16 (30%)	30 (104%)	36 (483%)	31 (1,250%)
<b>NAA vs. H3</b>					
May	-5 (-7%)	-10 (-17%)	-1 (-4%)	0 (0%)	-1 (-10%)
June	-1 (-1%)	-9 (-9%)	-12 (-13%)	-20 (-21%)	-27 (-31%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	19 (27%)	11 (19%)	9 (18%)	0 (0%)	5 (17%)

19  
20 Water temperature-related effects of H3 on green sturgeon spawning, egg incubation, and rearing  
21 habitat in the Feather River were also evaluated by determining the total degree-months exceeding  
22 the 64°F temperature threshold at Gridley (Table 11-4-102). Effects on spawning and egg incubation  
23 are evaluated here for May and June; effects on rearing are evaluated under Impact AQUA-131.  
24 Combining water years, total degree-months exceeding the threshold during May and June under H3  
25 would be 8% to 21% lower relative to NAA. Within months, total degree-months under H3 would be  
26 similar or up to 26% lower than that under NAA depending on water year type. These results  
27 indicate that there would be a small to moderate benefit of H3 to green sturgeon spawning and egg  
28 incubation temperature-related conditions in the Feather River.

1 **Table 11-4-102. Differences between Baselines and H3 in Total Degree-Months (°F-Months) by**  
 2 **Month and Water Year Type for Water Temperature Exceedances above 64°F in the Feather River**  
 3 **at Gridley, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
May	Wet	19 (317%)	-5 (-17%)
	Above Normal	12 (109%)	-2 (-8%)
	Below Normal	19 (238%)	-5 (-16%)
	Dry	28 (200%)	-1 (-2%)
	Critical	20 (118%)	0 (0%)
	All	98 (175%)	-13 (-8%)
June	Wet	18 (24%)	-49 (-35%)
	Above Normal	0 (0%)	-29 (-36%)
	Below Normal	0 (0%)	-32 (-33%)
	Dry	46 (49%)	-7 (-5%)
	Critical	36 (64%)	-3 (-3%)
	All	100 (29%)	-120 (-21%)
July	Wet	33 (20%)	17 (9%)
	Above Normal	17 (32%)	0 (0%)
	Below Normal	42 (62%)	10 (10%)
	Dry	87 (101%)	43 (33%)
	Critical	83 (105%)	29 (22%)
	All	262 (58%)	99 (16%)
August	Wet	46 (26%)	29 (15%)
	Above Normal	37 (82%)	15 (22%)
	Below Normal	50 (71%)	18 (18%)
	Dry	99 (146%)	21 (14%)
	Critical	49 (58%)	-1 (-1%)
	All	281 (63%)	82 (13%)
September	Wet	-4 (-10%)	23 (192%)
	Above Normal	11 (69%)	20 (286%)
	Below Normal	34 (121%)	-6 (-9%)
	Dry	48 (171%)	-4 (-5%)
	Critical	52 (260%)	-2 (-3%)
	All	141 (108%)	31 (13%)

4  
5 **San Joaquin River**

6 Flows in the San Joaquin River under H3 would be the same as those under NAA throughout the  
 7 March through June period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 **H1/LOS**

2 ***Sacramento River***

3 Mean monthly flows in the Sacramento River at Keswick and upstream of Red Bluff during the  
4 March through July spawning and egg incubation period for green sturgeon would be similar  
5 between H1 and H3 although flows can be lower or higher in individual months of individual years  
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
8 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
10 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
11 NAA and H1 in any month or water year type throughout the period.

12 There would be no differences between NAA and H1 in the number of years with each level of  
13 concern in the Sacramento River at Bend Bridge (Table 11-4-103).

14 **Table 11-4-103. Differences between Baseline Scenarios and H1 and H4 Scenarios in the Number**  
15 **of Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern,**  
16 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING		EXISTING	
	CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
Red	8 (200%)	-1 (-8%)	9 (225%)	0 (0%)
Orange	1 (100%)	1 (100%)	-1 (-100%)	-1 (-100%)
Yellow	0 (0%)	-3 (-60%)	-1 (-50%)	-4 (-80%)
None	-9 (-12%)	3 (5%)	-7 (-9%)	5 (8%)

17

18 Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge  
19 under H1 would be 8% to 16% higher than under NAA during July through September and 11% to  
20 12% lower during May and June (Table 11-4-104).

1 **Table 11-4-104. Differences between Baseline Scenarios and H1 and H4 Scenarios in Total Degree-**  
 2 **Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in**  
 3 **the Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
May	Wet	1,050 (279%)	-152 (-10%)	1,109 (294%)	-93 (-6%)
	Above Normal	273 (128%)	-82 (-14%)	290 (136%)	-65 (-11%)
	Below Normal	429 (196%)	-34 (-5%)	493 (225%)	30 (4%)
	Dry	216 (116%)	-198 (-33%)	392 (211%)	-22 (-4%)
	Critical	428 (194%)	18 (3%)	392 (177%)	-18 (-3%)
	All	2,396 (197%)	-448 (-11%)	2,676 (220%)	-168 (-4%)
June	Wet	468 (122%)	-243 (-22%)	645 (168%)	-66 (-6%)
	Above Normal	91 (61%)	-138 (-37%)	247 (167%)	18 (5%)
	Below Normal	245 (176%)	-107 (-22%)	374 (269%)	22 (4%)
	Dry	458 (244%)	-76 (-11%)	576 (306%)	42 (6%)
	Critical	671 (167%)	121 (13%)	607 (151%)	57 (6%)
	All	1,933 (153%)	-443 (-12%)	2,449 (194%)	73 (2%)
July	Wet	658 (127%)	52 (5%)	633 (122%)	27 (2%)
	Above Normal	352 (435%)	82 (23%)	299 (369%)	29 (8%)
	Below Normal	621 (422%)	165 (27%)	506 (344%)	50 (8%)
	Dry	1,162 (412%)	234 (19%)	1,033 (366%)	105 (9%)
	Critical	1,731 (210%)	-55 (-2%)	1,438 (174.5%)	-348 (-13%)
	All	4,524 (244%)	478 (8%)	3,909 (211%)	-137 (-2%)
August	Wet	2,153 (309%)	190 (7%)	1,861 (267%)	-102 (-4%)
	Above Normal	816 (200%)	157 (15%)	593 (145%)	-66 (-6%)
	Below Normal	1,302 (491%)	267 (21%)	1,010 (381%)	-25 (-2%)
	Dry	2,003 (299%)	393 (17%)	1,577 (235%)	-33 (-1%)
	Critical	2,605 (175%)	-14 (-0.3%)	2,284 (154%)	-335 (-8%)
	All	8,879 (252%)	993 (9%)	7,325 (208%)	-561 (-5%)
September	Wet	2,321 (314%)	1,612 (111%)	681 (92%)	-28 (-2%)
	Above Normal	1,025 (144%)	625 (56%)	406 (57%)	6 (1%)
	Below Normal	1,278 (171%)	132 (7%)	1,289 (173%)	143 (8%)
	Dry	2,206 (173%)	-390 (-10%)	2,178 (171%)	-418 (-11%)
	Critical	1,843 (89%)	-48 (-1%)	1,691 (81%)	-200 (-5%)
	All	8,673 (156%)	1,931 (16%)	6,245 (112%)	-497 (-4%)

4

5 **Feather River**

6 Flows under H1 in the Feather River between Thermalito Afterbay and the confluence with the  
 7 Sacramento River during the February through June period would generally be similar to or greater  
 8 than flows under H3 except in critical years during February at Thermalito (5% lower) (Appendix  
 9 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
 11 February through June green sturgeon spawning and egg incubation period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
 2 *Fish Analysis*). There would be no differences (<5%) between NAA and H1 in any month during the  
 3 period.

4 The percent of months exceeding the 64°F NMFS threshold during May and June under H1 would be  
 5 similar to or up to 27% lower than that under NAA, representing a small to moderate benefit of H1  
 6 (Table 11-4-105).

7 **Table 11-4-105. Differences between Baselines and H1 and H4 Scenarios in Percent of Months**  
 8 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**  
 9 **River at Gridley Exceed the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
<b>EXISTING CONDITIONS vs. H1</b>					
May	30 (92%)	21 (113%)	12 (125%)	12 (333%)	7 (300%)
June	4 (4%)	1 (1%)	0 (0%)	4 (6%)	12 (26%)
July	0 (0%)	0 (0%)	0 (0%)	9 (10%)	23 (34%)
August	0 (0%)	0 (0%)	9 (9%)	16 (20%)	32 (52%)
September	26 (38%)	32 (59%)	44 (157%)	52 (700%)	37 (1,500%)
<b>NAA vs. H1</b>					
May	-10 (-14%)	-17 (-30%)	-10 (-31%)	-2 (-13%)	-2 (-20%)
June	-2 (-3%)	-7 (-8%)	-16 (-17%)	-25 (-27%)	-27 (-31%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-5 (-5%)
August	0 (0%)	0 (0%)	0 (0%)	-4 (-4%)	-2 (-3%)
September	27 (40%)	27 (46%)	23 (48%)	16 (37%)	11 (39%)
<b>EXISTING CONDITIONS vs. H4</b>					
May	21 (65%)	16 (87%)	9 (88%)	7 (200%)	6 (250%)
June	2 (3%)	4 (4%)	5 (6%)	10 (15%)	21 (44%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	28 (41%)
August	0 (0%)	0 (0%)	9 (9%)	20 (25%)	38 (62%)
September	11 (16%)	15 (27%)	33 (117%)	41 (550%)	35 (1,400%)
<b>NAA vs. H4</b>					
May	-19 (-26%)	-22 (-39%)	-14 (-42%)	-7 (-40%)	-4 (-30%)
June	-4 (-4%)	-5 (-5%)	-11 (-12%)	-19 (-20%)	-19 (-21%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (4%)
September	12 (18%)	10 (17%)	12 (25%)	5 (11%)	9 (30%)

10  
 11 Combining water years, total degree-months exceeding the 64°F NMFS threshold during May and  
 12 June under H1 would be 7% to 21% lower relative to NAA. Within months, total degree-months  
 13 under H1 would be similar or up to 36% lower than that under NAA depending on water year type.  
 14 These results indicate that there would be a small to moderate benefit of H1 to green sturgeon  
 15 spawning and egg incubation temperature-related conditions in the Feather River (Table 11-4-106).

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**Table 11-4-106. Differences between Baselines and H1 and H4 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 64°F in the Feather River at Gridley, May through September**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
May	Wet	20 (333%)	-4 (-13%)	15 (250%)	-9 (-30%)
	Above Normal	11 (100%)	-3 (-12%)	1 (9%)	-13 (-52%)
	Below Normal	21 (263%)	-3 (-9%)	16 (200%)	-8 (-25%)
	Dry	26 (186%)	-3 (-7%)	23 (164%)	-6 (-14%)
	Critical	21 (124%)	1 (3%)	21 (124%)	1 (3%)
	All	99 (177%)	-12 (-7%)	76 (136%)	-35 (-21%)
June	Wet	27 (36%)	-40 (-28%)	61 (81%)	-6 (-4%)
	Above Normal	0 (0%)	-29 (-36%)	25 (49%)	-4 (-5%)
	Below Normal	-2 (-3%)	-34 (-35%)	10 (15%)	-22 (-23%)
	Dry	41 (44%)	-12 (-8%)	46 (49%)	-7 (-5%)
	Critical	36 (64%)	-3 (-3%)	37 (66%)	-2 (-2%)
	All	103 (30%)	-117 (-21%)	179 (52%)	-41 (-7%)
July	Wet	35 (21%)	19 (10%)	64 (38%)	48 (26%)
	Above Normal	18 (34%)	1 (1%)	43 (81%)	26 (37%)
	Below Normal	43 (63%)	11 (11%)	54 (79%)	22 (22%)
	Dry	80 (93%)	36 (28%)	94 (109%)	50 (38%)
	Critical	78 (99%)	24 (18%)	72 (91%)	18 (14%)
	All	255 (56%)	92 (15%)	328 (72%)	165 (27%)
August	Wet	45 (25%)	28 (14%)	77 (43%)	60 (31%)
	Above Normal	36 (80%)	14 (21%)	51 (113%)	29 (43%)
	Below Normal	46 (66%)	14 (14%)	67 (96%)	35 (34%)
	Dry	92 (135%)	14 (10%)	98 (144%)	20 (14%)
	Critical	47 (55%)	-3 (-2%)	50 (59%)	0 (0%)
	All	267 (60%)	68 (11%)	344 (77%)	145 (22%)
September	Wet	60 (154%)	87 (725%)	24 (62%)	51 (425%)
	Above Normal	18 (113%)	27 (386%)	21 (131%)	30 (429%)
	Below Normal	35 (125%)	-5 (-7%)	48 (171%)	8 (12%)
	Dry	46 (164%)	-6 (-8%)	48 (171%)	-4 (-5%)
	Critical	50 (250%)	-4 (-5%)	47 (235%)	-7 (-9%)
	All	209 (160%)	99 (41%)	187 (143%)	77 (32%)

4

**San Joaquin River**

Flows under H1 in the San Joaquin River during the March through June period would be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature modeling was in the San Joaquin River.

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1 **H4/HOS**

2 ***Sacramento River***

3 Mean monthly flows in the Sacramento River at Keswick and upstream of Red Bluff during the  
4 March through July spawning and egg incubation period for green sturgeon would generally be  
5 similar between H4 and H3, except during June in which flows would be up to 13% lower under H4  
6 depending on water year type and 5% and 7% lower during July in dry years (Keswick and  
7 upstream of Red Bluff, respectively) although flows can be lower or higher in individual months of  
8 individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These  
9 reductions would not be large or frequent enough to have a biologically meaningful effect on green  
10 sturgeon spawning habitat.

11 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
12 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
15 NAA and H4 in any month or water year type throughout the period.

16 There would be no differences between NAA and H4 in the number of years with each level of  
17 concern in the Sacramento River at Bend Bridge (Table 11-4-103).

18 Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge  
19 under H4 would be similar to those under NAA in all months during the period except August, in  
20 which there would be a 5% reduction in exceedances (Table 11-4-104).

21 ***Feather River***

22 Flows under H4 in the Feather River between Thermalito Afterbay and the confluence with the  
23 Sacramento River during the February through June period would generally be similar to or greater  
24 than flows under H3, except during June, in which flows would be up to 38% lower under H4  
25 depending on water year type and during July in dry years at Thermalito when the flows would be  
26 7% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These reductions  
27 would not be large or frequent enough to have a biologically meaningful effect on green sturgeon  
28 spawning habitat.

29 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
30 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
31 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
32 *Fish Analysis*). There would be no differences (<5%) between NAA and H4 in any other month  
33 during the period.

34 The percent of months exceeding the 64°F NMFS threshold during May and June under H4 would be  
35 similar to or up to 22% lower than that under NAA, representing a small to moderate benefit of H4  
36 (Table 11-4-105).

37 Combining water years, total degree-months exceeding the 64°F NMFS threshold during May and  
38 June under H4 would be 7% to 21% lower relative to NAA. Within months, total degree-months  
39 under H4 would be similar or up to 52% lower than that under NAA depending on water year type.  
40 These results indicate that there would be a small to moderate benefit of H4 to green sturgeon  
41 spawning and egg incubation temperature-related conditions in the Feather River (Table 11-4-106).

1 **San Joaquin River**

2 Flows under H4 in the San Joaquin River during the period would be similar to flows under H3  
3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 No water temperature modeling was in the San Joaquin River.

5 **NEPA Effects:** Collectively, these results indicate that this effect is not adverse because it does not  
6 have the potential to substantially reduce the amount of suitable habitat. There would generally be  
7 higher flows in the Sacramento and Feather rivers that would benefit spawning and egg incubation  
8 conditions for green sturgeon. Water temperatures in the Sacramento River would not differ from  
9 those under NAA, and temperature conditions under Alternative 4 would be better than those under  
10 NAA in the Sacramento and Feather Rivers. Temperature conditions would slightly improve under  
11 H4 relative to H1 and H3 during spring months.

12 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
13 and quality of spawning and egg incubation habitat for green sturgeon would not be affected relative  
14 to the CEQA baseline.

15 **H3/ESO**

16 **Sacramento River**

17 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red  
18 Bluff during the March to July spawning and egg incubation period for green sturgeon (Appendix  
19 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would generally be similar  
20 to or greater than those under Existing Conditions, except in July during critical years (10% and 9%  
21 lower, depending on location), in May during wet years (17% and 21% lower, depending on  
22 location), March during below normal years (10% to 18% lower, depending on location), and April  
23 during above normal years at Keswick (6% lower). Also, flows can be lower or higher in individual  
24 months of individual years. These results indicate that there would be few reductions and multiple  
25 increases in flows in the Sacramento River under H3 relative to Existing Conditions.

26 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
27 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
28 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
29 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
30 Existing Conditions and H3 in any month or water year type throughout the period.

31 There would be 10 more years with a “red” NMFS level of concern in the Sacramento River at Bend  
32 Bridge under H3 than under Existing Conditions (Table 11-4-99).

33 Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge  
34 under H3 would be 132% to 254% higher than under Existing Conditions during the May through  
35 September period (Table 11-4-100).

36 **Feather River**

37 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with  
38 the Sacramento River during the February through June green sturgeon spawning and egg  
39 incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Thermalito,  
40 flows under H3 would generally be similar to or greater than those under Existing Conditions,

1 except during March in below normal years and May in wet years, in which flows under H3 would be  
2 up to 53% lower than under Existing Conditions and except in above normal, below normal, and dry  
3 years during February (35%, 46%, and 14%, respectively). At the confluence with the Sacramento  
4 River, flows under H3 would generally be similar to or greater than flows under Existing Conditions,  
5 except during March in below normal years, May in wet years, and in June in wet and critical years,  
6 in which flows under H3 would be up to 26% lower than under Existing Conditions, and in normal  
7 years during February (11% lower). These results indicate that there would generally be greater  
8 flows in the Feather River under H3 relative to Existing Conditions with few exceptions.

9 Water temperature-related effects of H3 on green sturgeon spawning, egg incubation, and rearing  
10 habitat in the Feather River were evaluated by determining the percent of months during May  
11 through September in which water temperatures exceed a 64°F temperature threshold at Gridley  
12 (Table 11-4-101). Effects on spawning and egg incubation are evaluated here for May and June;  
13 effects on rearing are evaluated under Impact AQUA-131. The percent of months exceeding the  
14 threshold during May and June under H3 would be similar to or up to 35% greater than that under  
15 Existing Conditions, representing a small to moderate negative effect of H3. This analysis includes  
16 the effect of climate change.

17 Water temperature-related effects of H3 on green sturgeon spawning, egg incubation, and rearing  
18 habitat in the Feather River were also evaluated by determining the total degree-months exceeding  
19 the 64°F temperature threshold at Gridley (Table 11-4-102). Effects on spawning and egg incubation  
20 are evaluated here for May and June; effects on rearing are evaluated under Impact AQUA-131.  
21 Combining water years, total degree-months exceeding the threshold during May and June under H3  
22 would be 29% to 175% greater relative to Existing Conditions. Within months, total degree-months  
23 under H3 would be similar or up to 317% lower than that under Existing Conditions depending on  
24 water year type. These results indicate that there would be a moderate to large negative effect of H3  
25 on green sturgeon spawning and egg incubation temperature-related conditions in the Feather  
26 River. This analysis includes the effect of climate change.

### 27 ***San Joaquin River***

28 Flows in the San Joaquin River under H3 similar to those under Existing Conditions throughout the  
29 March through June spawning and egg incubation period for green sturgeon, except during June, in  
30 which there would be a 30% flow reduction under H3 (Appendix 11C, *CALSIM II Model Results*  
31 *utilized in the Fish Analysis*).

32 No water temperatures modeling was conducted in the San Joaquin River.

### 33 **H1/LOS**

#### 34 ***Sacramento River***

35 Mean monthly flows in the Sacramento River at Keswick and upstream of Red Bluff during the  
36 March through July spawning and egg incubation period for green sturgeon would be similar  
37 between H1 and H3 although flows can be lower or higher in individual months of individual years  
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) except in critical years during  
39 July (16% lower).

40 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
41 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
42 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
2 Existing Conditions and H1 in any month or water year type throughout the period.

3 There would be 8 more years with a “red” NMFS level of concern in the Sacramento River at Bend  
4 Bridge under H1 than under Existing Conditions (Table 11-4-103).

5 Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge  
6 under H1 would be 156% to 252% higher than under Existing Conditions during the May through  
7 September period (Table 11-4-104).

#### 8 **Feather River**

9 Flows under H1 in the Feather River between Thermalito Afterbay and the confluence with the  
10 Sacramento River during the February through June period would generally be similar to or greater  
11 than flows under H3 except in below normal, dry and critical years (29%, 8%, and 13% lower,  
12 respectively) (Thermalito) and in critical years (7% lower) (Sacramento River confluence) during  
13 February (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
15 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
17 *Fish Analysis*). Mean monthly water temperatures under H1 would be 6% lower than those under  
18 Existing Conditions during February, but there would be no differences (<5%) in any other month  
19 during the period.

20 The percent of months exceeding the 64°F NMFS threshold during May and June under H1 would be  
21 similar to or up to 30% greater than that under Existing Conditions, representing a small to  
22 moderate negative effect of H1 (Table 11-4-105). This analysis includes climate change.

23 Combining water years, total degree-months exceeding the threshold during May and June under H1  
24 would be 30% to 177% greater relative to Existing Conditions. Within months, total degree-months  
25 under H1 would be similar or up to 333% lower than that under Existing Conditions depending on  
26 water year type. These results indicate that there would be a moderate to large negative effect of H1  
27 on green sturgeon spawning and egg incubation temperature-related conditions in the Feather  
28 River. This analysis includes the effect of climate change.

#### 29 **San Joaquin River**

30 Flows in the San Joaquin River under H1 similar to those under Existing Conditions throughout the  
31 March through June spawning and egg incubation period for green sturgeon, except during June, in  
32 which there would be a 30% flow reduction under H1 (Appendix 11C, *CALSIM II Model Results*  
33 *utilized in the Fish Analysis*).

34 No water temperature modeling was in the San Joaquin River.

#### 35 **H4/HOS**

#### 36 **Sacramento River**

37 Mean monthly flows in the Sacramento River at Keswick and upstream of Red Bluff during the  
38 March through July spawning and egg incubation period for green sturgeon would generally be  
39 similar between H4 and H3, except during June in which flows would be up to 13% lower under H4

1 depending on water year type and during July in critical years when flows would be 7% or 8% lower  
2 although flows can be lower or higher in individual months of individual years (Appendix 11C,  
3 *CALSIM II Model Results utilized in the Fish Analysis*). These reductions would not be large or  
4 frequent enough to have a biologically meaningful effect on green sturgeon spawning habitat.

5 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
6 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,  
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
8 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between  
9 Existing Conditions and H4 in any month or water year type throughout the period, except in wet  
10 years during May (5% higher under H4).

11 There would be 9 more years with a “red” NMFS level of concern in the Sacramento River at Bend  
12 Bridge under H4 than under Existing Conditions (Table 11-4-103).

13 Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge  
14 under H4 would be 112% to 220% higher than under Existing Conditions during the May through  
15 September period (Table 11-4-104).

#### 16 ***Feather River***

17 Flows under H1 in the Feather River between Thermalito Afterbay and the confluence with the  
18 Sacramento River during the February through June period would generally be similar to or greater  
19 than flows under H3, except during June, in which flows would be up to 38% lower under H4  
20 depending on water year type and during February in below normal, dry and critical years (30%,  
21 15%, and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
22 *Analysis*). These reductions would not be large or frequent enough to have a biologically meaningful  
23 effect on green sturgeon spawning habitat.

24 Mean monthly water temperatures in the Feather River at Gridley were examined during the  
25 February through June green sturgeon spawning and egg incubation period (Appendix 11D,  
26 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*  
27 *Fish Analysis*). Mean monthly water temperatures under H4 would be 6% lower than those under  
28 Existing Conditions during February, but there would be no differences (<5%) in any other month  
29 during the period.

30 The percent of months exceeding the 64°F NMFS threshold during May and June under H4 would be  
31 similar to or up to 21% greater than that under Existing Conditions, representing a small to  
32 moderate negative effect of H4 (Table 11-4-105). This analysis includes climate change.

33 Combining water years, total degree-months exceeding the threshold during May and June under H4  
34 would be 52% to 136% greater relative to Existing Conditions. Within months, total degree-months  
35 under H4 would be similar or up to 250% lower than that under Existing Conditions depending on  
36 water year type. These results indicate that there would be a moderate to large negative effect of H4  
37 on green sturgeon spawning and egg incubation temperature-related conditions in the Feather  
38 River. This analysis includes the effect of climate change.

#### 39 ***San Joaquin River***

40 Flows in the San Joaquin River under H1 similar to those under Existing Conditions throughout the  
41 March through June spawning and egg incubation period for green sturgeon, except during June, in

1 which there would be a 30% flow reduction under H1 (Appendix 11C, *CALSIM II Model Results*  
2 *utilized in the Fish Analysis*).

3 No water temperature modeling was in the San Joaquin River.

#### 4 **Summary of CEQA Conclusion**

5 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between  
6 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
7 alternative could substantially reduce the amount of suitable spawning and egg incubation habitat  
8 for green sturgeon, contrary to the NEPA conclusion set forth above. Flows would generally not  
9 differ under Alternative 4 in the Sacramento, Feather, and San Joaquin Rivers and temperatures  
10 would not differ in the Sacramento River. However, exceedances above temperature thresholds by  
11 NMFS would be higher in the Sacramento and Feather Rivers. Results would generally be consistent  
12 among scenarios.

13 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
14 change, future water demands, and implementation of the alternative. The analysis described above  
15 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
16 alternative from those of sea level rise, climate change and future water demands using the model  
17 simulation results presented in this chapter. However, the increment of change attributable to the  
18 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
19 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
20 implementation period, which does include future sea level rise, climate change, and water  
21 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
22 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
23 effect of the alternative from those of sea level rise, climate change, and water demands.

24 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
25 term implementation period and H3 indicates that flows in the locations and during the months  
26 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
27 indicates that the differences between Existing Conditions and Alternative 4 found above would  
28 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
29 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
30 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
31 impact on spawning habitat for green sturgeon. This impact is found to be less than significant and  
32 no mitigation is required.

#### 33 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

34 In general, Alternative 4 would not affect the quantity and quality of green sturgeon larval and  
35 juvenile rearing habitat relative to the NAA.

#### 36 **H3/ESO**

37 Water temperature was used to determine the potential effects of H3 on green sturgeon larval and  
38 juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their  
39 habitat is more likely to be limited by changes in water temperature than flow rates.

1       **Sacramento River**

2       Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
3       the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
4       *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
5       would be no differences (<5%) in mean monthly water temperature between NAA and H3 in any  
6       month or water year type throughout the period.

7       **Feather River**

8       Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
9       through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
10       *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
11       be no differences (<5%) in mean monthly water temperature between NAA and H3 in any month or  
12       water year type throughout the period.

13       Water temperature-related effects of H3 on green sturgeon rearing habitat in the Feather River were  
14       evaluated by determining the percent of months during May through September in which water  
15       temperatures exceed a 64°F temperature threshold at Gridley (Table 11-4-101). The percent of  
16       months exceeding the threshold under H3 would be similar to or up to 27% lower than that under  
17       NAA during May and June, similar to that under NAA during July and August, and similar to or up to  
18       19% greater than that under NAA during September.

19       Water temperature-related effects of H3 on green sturgeon rearing habitat in the Feather River were  
20       also evaluated by determining the total degree-months exceeding the 64°F temperature threshold at  
21       Gridley (Table 11-4-102). Combining water years, total degree-months exceeding the threshold  
22       under H3 would be 8% to 31% lower relative to NAA during May and June and 13% to 126% higher  
23       during July through September. These results indicate that there would be both beneficial and  
24       negative temperature-related effects to green sturgeon rearing in the Feather River.

25       **San Joaquin River**

26       Water temperature modeling was not conducted in the San Joaquin River.

27       **H1/LOS**

28       **Sacramento River**

29       Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
30       the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
31       *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
32       would be no differences (<5%) in mean monthly water temperature between NAA and H1 in any  
33       month or water year type throughout the period.

34       **Feather River**

35       Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
36       through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
37       *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
38       be no differences (<5%) in mean monthly water temperature between NAA and H1 in any month or  
39       water year type throughout the period.

1 The percent of months exceeding the 64°F NMFS threshold under H1 would be similar to or up to  
2 27% lower than that under NAA during May and June, generally similar to that under NAA during  
3 July and August, and 11% to 27% greater than that under NAA during September. (Table 11-4-105).

4 Combining water years, total degree-months exceeding the 64°F NMFS threshold under H1 would be  
5 7% to 21% lower relative to NAA during May and June and 11% to 41% higher during July through  
6 September (Table 11-4-106). These results indicate that there would be both beneficial and negative  
7 temperature-related effects of H1 on green sturgeon rearing in the Feather River.

8 Regardless of the results of these analyses, all current applicable regulatory standards for the  
9 Feather River in the NMFS BiOp (NMFS 2009) would be met under H1 at the same frequency as are  
10 being met currently under the NEPA point of comparison. Therefore, regardless of these results, H1  
11 would be protective of green sturgeon as defined by NMFS (2009).

#### 12 ***San Joaquin River***

13 Water temperature modeling was not conducted in the San Joaquin River.

#### 14 **H4/HOS**

#### 15 ***Sacramento River***

16 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
17 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
18 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
19 would be no differences (<5%) in mean monthly water temperature between NAA and H4 in any  
20 month or water year type throughout the period.

#### 21 ***Feather River***

22 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
23 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
24 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
25 be no differences (<5%) in mean monthly water temperature between NAA and H4 in any month or  
26 water year type throughout the period.

27 The percent of months exceeding the 64°F NMFS threshold under H4 would be similar to or up to  
28 22% lower than that under NAA during May and June, similar to that under NAA during July and  
29 August, and 5% to 12% greater than that under NAA during September. (Table 11-4-105).

30 Combining water years, total degree-months exceeding the 64°F NMFS threshold under H4 would be  
31 7% to 21% lower relative to NAA during May and June and 22% to 32% higher during July through  
32 September (Table 11-4-106). These results indicate that there would be both beneficial and negative  
33 temperature-related effects of H4 on green sturgeon rearing in the Feather River.

#### 34 ***San Joaquin River***

35 Water temperature modeling was not conducted in the San Joaquin River.

36 ***NEPA Effects:*** Collectively, these results indicate that the effect would not be adverse because it does  
37 not have the potential to substantially reduce the amount of suitable habitat. Water temperatures in  
38 the Sacramento and Feather rivers and exceedances of NMFS temperature thresholds in the Feather

1 River under Alternative 4 would be similar to those under NAA. These results would be consistent  
2 among scenarios.

3 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
4 and quality of green sturgeon rearing habitat would not be affected relative to the CEQA baseline.

### 5 **H3/ESO**

6 Water temperature was used to determine the potential effects of H3 on green sturgeon larval and  
7 juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their  
8 habitat is more likely to be limited by changes in water temperature than flow rates.

### 9 **Sacramento River**

10 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
11 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
12 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
13 would be no differences (<5%) in mean monthly water temperature between Existing Conditions  
14 and H3 during May through July and 5% to 6% lower during August through October.

### 15 **Feather River**

16 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
17 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
18 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
19 be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in  
20 any month throughout the period, except during October (6% higher under H3).

21 Water temperature-related effects of H3 on green sturgeon rearing habitat in the Feather River were  
22 evaluated by determining the percent of months during May through September in which water  
23 temperatures exceed a 64°F temperature threshold at Gridley (Table 11-4-101). The percent of  
24 months exceeding the threshold under H3 would generally be greater by up to 35% than the percent  
25 under Existing Conditions during all months. These results include the effects of climate change.

26 Water temperature-related effects of H3 on green sturgeon rearing habitat in the Feather River were  
27 also evaluated by determining the total degree-months exceeding the 64°F temperature threshold at  
28 Gridley (Table 11-4-102). Combining water years, total degree-months exceeding the threshold  
29 under H3 would be 29% to 175% higher in all months. These results indicate that there would be  
30 negative temperature-related effects of H3 on green sturgeon rearing in the Feather River. These  
31 results include the effects of climate change.

### 32 **San Joaquin River**

33 Water temperature modeling was not conducted in the San Joaquin River.

### 34 **H1/LOS**

### 35 **Sacramento River**

36 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
37 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
38 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There

1 would be no differences (<5%) in mean monthly water temperature between Existing Conditions  
2 and H1 during May through July and 5% to 6% lower during August through October.

3 **Feather River**

4 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
5 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
6 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
7 be no differences (<5%) in mean monthly water temperature between Existing Conditions and H1 in  
8 any month throughout the period, except during October (5% higher under H1).

9 The percent of months exceeding the 64°F NMFS threshold under H1 would generally be greater by  
10 up to 52% than the percent under Existing Conditions during all months (Table 11-4-105). These  
11 results include the effects of climate change.

12 Combining water years, total degree-months exceeding the 64°F NMFS threshold under H1 would be  
13 30% to 177% higher in all months (Table 11-4-106). These results indicate that there would be  
14 negative temperature-related effects of H1 on green sturgeon rearing in the Feather River. These  
15 results include the effects of climate change.

16 **San Joaquin River**

17 Water temperature modeling was not conducted in the San Joaquin River.

18 **H4/HOS**

19 **Sacramento River**

20 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during  
21 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*  
22 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There  
23 would be no differences (<5%) in mean monthly water temperature between Existing Conditions  
24 and H4 during May through July and 5% lower during August and October.

25 **Feather River**

26 Mean monthly water temperatures in the Feather River at Gridley were examined during the April  
27 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
28 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
29 be no differences (<5%) in mean monthly water temperature between Existing Conditions and H4 in  
30 any month throughout the period, except during July, August, and October (5% to 7% higher under  
31 H4).

32 The percent of months exceeding the 64°F NMFS threshold under H4 would generally be greater by  
33 up to 41% than the percent under Existing Conditions during all months (Table 11-4-105). These  
34 results include the effects of climate change.

35 Combining water years, total degree-months exceeding the 64°F NMFS threshold under H4 would be  
36 52% to 143% higher in all months (Table 11-4-106). These results indicate that there would be  
37 negative temperature-related effects of H4 on green sturgeon rearing in the Feather River. These  
38 results include the effects of climate change.

1 **San Joaquin River**

2 Water temperature modeling was not conducted in the San Joaquin River.

3 **Summary of CEQA Conclusion**

4 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between  
5 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
6 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set  
7 forth above. Water temperatures be similar in the Sacramento River, although the exceedance above  
8 NMFS temperature thresholds in the Feather River would be higher under Alternative 4 than those  
9 under the CEQA baseline, which could increase stress, mortality, and susceptibility to disease for  
10 larval and juvenile green sturgeon. These results are consistent among scenarios.

11 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
12 change, future water demands, and implementation of the alternative. The analysis described above  
13 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
14 alternative from those of sea level rise, climate change and future water demands using the model  
15 simulation results presented in this chapter. However, the increment of change attributable to the  
16 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
17 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
18 implementation period, which does include future sea level rise, climate change, and water  
19 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
20 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
21 effect of the alternative from those of sea level rise, climate change, and water demands.

22 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
23 term implementation period and H3 indicates that flows in the locations and during the months  
24 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
25 indicates that the differences between Existing Conditions and Alternative 4 found above would  
26 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
27 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
28 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
29 impact on rearing habitat for green sturgeon. This impact is found to be less than significant and no  
30 mitigation is required.

31 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

32 In general, effects of Alternative 4 on green sturgeon migration conditions relative to the NAA are  
33 uncertain.

34 **Upstream of the Delta**

35 **H3/ESO**

36 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
37 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with  
38 the Sacramento River during the April through October larval migration period, the August through  
39 March juvenile migration period, and the November through June adult migration period (Appendix  
40 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the  
41 entire year, flows during all months were compared. Reduced flows could slow or inhibit

1 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration  
2 cues and pass impediments by adults.

3 Sacramento River flows at Keswick under H3 would generally be lower than flows under NAA  
4 during November, greater during May and June, and similar to flows under NAA in the remaining  
5 nine months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Sacramento River  
6 flows at Wilkins Slough under H3 would generally be lower than flows under NAA during November,  
7 greater during May and June, and similar to flows under NAA in the remaining nine months  
8 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 Feather River flows at Thermalito under H3 would generally be lower than flows under NAA during  
10 July through September, greater during March through June and October, and similar to flows under  
11 NAA in the remaining four months (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
12 Analysis*). However, given the benthic nature of green sturgeon and that flows in the Feather River  
13 would be consistent with the flow schedule provided by NMFS during the BDCP planning process,  
14 these reductions in summer flows are not expected to have a substantial effect on green sturgeon in  
15 the Feather River.

16 Feather River flows at the confluence with the Sacramento River under H3 would generally be lower  
17 than flows under NAA during July through September, greater during April through June and  
18 October, and similar to flows under NAA in the remaining five months (Appendix 11C, *CALSIM II  
19 Model Results utilized in the Fish Analysis*). However, given the benthic nature of green sturgeon and  
20 that flows in the Feather River would be consistent with the flow schedule provided by NMFS during  
21 the BDCP planning process, these reductions in summer flows are not expected to have a substantial  
22 effect on green sturgeon in the Feather River.

23 Larval transport flows were also examined by utilizing the positive correlation between white  
24 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the  
25 assumption that the mechanism responsible for the relationship is that Delta outflow provides  
26 improved green sturgeon larval transport that results in improved year class strength. Results for  
27 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation  
28 between Delta outflow and year class strength, green sturgeon year class strength would be lower  
29 under H3 than those under NAA (up to 50% lower).

### 30 **H1/LOS**

31 Year-round flows under H1 in the Sacramento River at Keswick and Wilkins Slough would generally  
32 be similar to flows under H3, except during September and November, during which flows would be  
33 up to 46% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These isolated  
34 reductions would not have biologically meaningful effects on green sturgeon migration habitat.  
35 Year-round flows in the Feather River below Thermalito Afterbay (high-flow channel) and at the  
36 confluence with the Sacramento River under H1 would generally be similar to or greater than flows  
37 under H3, except during September during which flows would be up to 83% lower. This isolated  
38 reduction would not have biologically meaningful effects on green sturgeon migration habitat.  
39 Overall, results for H1 would be the same as those for H3.

### 40 **H4/HOS**

41 Year-round flows in the Sacramento River at Keswick and Wilkins Slough under H4 would generally  
42 be similar to flows under H3, except during May and June, during which flows would be up to 21%

1 lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These small and isolated  
2 reductions would not have biologically meaningful effects on green sturgeon migration habitat.  
3 Flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4 during January  
4 through May and November through December would generally be similar to or greater than flows  
5 under H3. However, flows during June through October would generally be up to 39% lower under  
6 H4. These reductions are expected to cause a biologically meaningful effect on green sturgeon  
7 migration habitat.

## 8 **Through-Delta**

9 The impact of Alternative 4 on in-Delta conditions for green sturgeon would be the same as  
10 described for splittail in Impact AQUA-114. The effect on green sturgeon would not be adverse.

11 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 4 and  
12 NAA. However, due to the removal of water at the North Delta intakes, there are substantial  
13 differences in through-Delta flows between Alternative 4 and NAA (see Table 11-4-114 below).  
14 Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green  
15 sturgeon, found a positive correlation between year class strength and Delta outflow during April  
16 and May. However, this conclusion was reached in the absence of north Delta intakes and the exact  
17 mechanism that causes this correlation is not known at this time. One hypothesis suggests that the  
18 correlation is caused by high flows in the upper river resulting in improved migration, spawning,  
19 and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation  
20 is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river  
21 to spawn. It is also possible that some combination of these factors are working together to produce  
22 the positive correlation between high flows and sturgeon year-class strength.

23 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation  
24 between year class strength and river/Delta flow will be addressed through targeted research and  
25 monitoring to be conducted in the years leading up to the initiation of north Delta facilities  
26 operations. If these targeted investigations determine that the primary mechanisms behind the  
27 positive correlation between high flows and sturgeon year-class strength are related to upstream  
28 conditions, then Alternative 4 would be deemed Not Adverse due to the similarities in upstream  
29 flow conditions between Alternative 4 and NAA. However, if the targeted investigations lead to a  
30 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and  
31 through-Delta flow conditions, then Alternative 4 would be deemed adverse due to the magnitude of  
32 reductions in through-Delta flow conditions in Alternative 4 as compared to NAA.

33 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, migration  
34 conditions for green sturgeon would not change relative to the CEQA baseline.

## 35 **Upstream of the Delta**

36 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between  
37 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with  
38 the Sacramento River during the April through October larval migration period, the August through  
39 March juvenile migration period, and the November through July adult migration period (Appendix  
40 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the  
41 entire year, flows during all months were compared. Reduced flows could slow or inhibit  
42 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration  
43 cues and pass impediments by adults.

1 Sacramento River flows between Keswick and Wilkins Slough under H3 would generally be lower  
2 than flows under Existing Conditions during August, September, and November by up to 29%,  
3 greater during February, May, and June, and similar to flows under Existing Conditions in the  
4 remaining six months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 For Delta outflow, the percent of months exceeding outflow thresholds under H3 would consistently  
6 be lower than those under Existing Conditions for each flow threshold, water year type, and month  
7 (8% to 50% lower on a relative scale) (see Table 11-4-114 below).

8 Feather River flows between Thermalito and the confluence with the Sacramento River under H3  
9 would generally be lower than flows under Existing Conditions during January, February, July,  
10 August and December by up to 64%, greater during April through June, September, and October by  
11 up to 209%, and similar to flows under Existing Conditions in March and November (Appendix 11C,  
12 *CALSIM II Model Results utilized in the Fish Analysis*).

### 13 **H1/LOS**

14 Year-round flows under H1 in the Sacramento River at Keswick and Wilkins Slough would generally  
15 be similar to flows under H3, except during September and November, during which flows would be  
16 up to 46% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These isolated  
17 reductions would not have biologically meaningful effects on green sturgeon migration habitat.  
18 Year-round flows in the Feather River below Thermalito Afterbay (high-flow channel) and at the  
19 confluence with the Sacramento River under H1 would generally be similar to or greater than flows  
20 under H3, except during September during which flows would be up to 83% lower. This isolated  
21 reduction would not have biologically meaningful effects on green sturgeon migration habitat.  
22 Overall, results for H1 would be the same as those for H3.

### 23 **H4/HOS**

24 Year-round flows in the Sacramento River at Keswick and Wilkins Slough under H4 would generally  
25 be similar to flows under H3, except during May and June, during which flows would be up to 21%  
26 lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These small and isolated  
27 reductions would not have biologically meaningful effects on green sturgeon migration habitat.  
28 Flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4 during January  
29 through May and November through December would generally be similar to or greater than flows  
30 under H3. However, flows during June through October would generally be up to 39% lower under  
31 H4. These reductions are expected to cause a biologically meaningful effect on green sturgeon  
32 migration habitat.

### 33 **Through-Delta**

34 As described above, the potential impact of Alternative 4 on in-Delta conditions for green sturgeon is  
35 considered less than significant, and no mitigation would be required.

### 36 **Summary of CEQA Conclusion**

37 Collectively, the results of the Impact AQUA-132 CEQA analysis indicate that the difference between  
38 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
39 alternative could substantially interfere with the movement of fish, contrary to the NEPA conclusion  
40 set forth above. The frequent small to large reductions in flows in the Sacramento and Feather  
41 Rivers would reduce the ability of all three life stages of green sturgeon to migrate successfully. Flow

1 reductions during June through October under H4 would further reduce migration conditions for all  
2 three life stages. Exceedance of Delta outflow thresholds would be lower under Alternative 4 than  
3 under Existing Conditions, although there is high uncertainty that year class strength is due to Delta  
4 outflow or if both year class strength and Delta outflows co-vary with another unknown factor.

5 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
6 change, future water demands, and implementation of the alternative. The analysis described above  
7 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
8 alternative from those of sea level rise, climate change and future water demands using the model  
9 simulation results presented in this chapter. However, the increment of change attributable to the  
10 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
11 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
12 implementation period, which does include future sea level rise, climate change, and water  
13 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
14 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
15 effect of the alternative from those of sea level rise, climate change, and water demands.

16 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
17 term implementation period and H3 indicates that flows in the locations and during the months  
18 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
19 indicates that the differences between Existing Conditions and Alternative 4 found above would  
20 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
21 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
22 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
23 impact on migration conditions for green sturgeon. This impact is found to be less than significant  
24 and no mitigation is required.

#### 25 **Restoration Measures (CM2, CM4–CM7, and CM10)**

26 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
27 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
28 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
29 restoration measures described for green sturgeon under Alternative 1A (Impacts AQUA-133  
30 through AQUA-135) also appropriately characterize effects under Alternative 4.

31 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 32 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

#### 33 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green** 34 **Sturgeon**

#### 35 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

36 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
37 on green sturgeon are the same for Alternative 4, as those described under Alternative 1A (Impacts  
38 AQUA 133-through AQUA-135). The effects would not be adverse, and would generally be beneficial.  
39 Specifically for AQUA-134, the effects of contaminants on green sturgeon with respect to copper,  
40 ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on green  
41 sturgeon are uncertain.

1 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or  
2 less than significant, and no mitigation is required.

3 **Other Conservation Measures (CM12–CM19 and CM21)**

4 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
5 differences in other conservation-related fish effects are anticipated anywhere in the affected  
6 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
7 effects of other conservation measures described for green sturgeon under Alternative 1A (Impacts  
8 AQUA-136 through AQUA-144) also appropriately characterize effects under Alternative 4.

9 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

10 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

11 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**  
12 **(CM13)**

13 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

14 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**  
15 **(CM15)**

16 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

17 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

18 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

19 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

20 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**  
21 **Sturgeon (CM21)**

22 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms  
23 on green sturgeon are the same as those described under Alternative 1A (Impacts AQUA-136  
24 through AQUA-144). The effects range from no effect, to not adverse, to beneficial.

25 **CEQA Conclusion:** The effects of the nine impact mechanisms listed above range from no impact, to  
26 less than significant, to beneficial, and no mitigation is required.

27 **White Sturgeon**

28 **Construction and Maintenance of CM1**

29 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

30 The potential effects of construction of the water conveyance facilities on white sturgeon would be  
31 similar to those described for Alternative 1A, Impact AQUA-145, except that Alternative 4 would  
32 include three intakes compared to five intakes under Alternative 1A, so the effects would be  
33 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing

1 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and  
2 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
3 would require 27.3 acres of dredging. Alternative 4 would use five barge locations rather than six as  
4 under Alternative 1A so those effects would also be proportionally less. Additionally, construction  
5 and excavation at Clifton Court Forebay would be done in the dry via installation of cofferdams for  
6 isolation and dewatering of work areas. Implementation of Appendix 3B, *Environmental*  
7 *Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize  
8 adverse effects as described for Alternative 1A. Mitigation measures would also be available to avoid  
9 and minimize potential effects.

10 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-145, the effect would not be adverse  
11 for white sturgeon.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-145, the impact of the construction  
13 of the water conveyance facilities on white sturgeon would not be significant except for construction  
14 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
15 because only three intakes would be constructed rather than five. Implementation of Mitigation  
16 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
17 significant.

18 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
19 **of Pile Driving and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
21 Alternative 1A.

22 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
23 **and Other Construction-Related Underwater Noise**

24 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
25 Alternative 1A.

26 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

27 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
28 Alternative 4 would be the same as those described for Alternative 1A, Impact AQUA-146, except  
29 that only three intakes would need to be maintained under Alternative 4, compared to the five  
30 intakes under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-146, the impact would  
31 not be adverse for white sturgeon.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance  
33 of water conveyance facilities on white sturgeon would be less than significant and no mitigation is  
34 required.

1 **Water Operations of CM1**

2 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

3 ***Water Exports***

4 The potential effects of the water operations under Alternative 4 would be the same as those  
5 described for green sturgeon (see Impact AQUA-129), which is a reduction in entrainment at the  
6 south Delta facilities, and avoidance or reduction of entrainment at the proposed north Delta  
7 diversion facilities and the NBA alternative intake. As concluded in Impact AQUA-129, the impact of  
8 Alternative 4 on white sturgeon would not be adverse.

9 ***Predation Associated with Entrainment***

10 The potential effects would be the same as described for green sturgeon in Alternative 4 (see Impact  
11 AQUA-129).

12 ***NEPA Effects:*** In conclusion, the effect of Alternative 4 operations on entrainment and associated  
13 predation of white sturgeon would not be adverse and may provide modest benefit due to reduced  
14 losses at the south Delta facilities.

15 ***CEQA Conclusion:*** As described above for green sturgeon (Impact AQUA-129) the impact of water  
16 operations on white sturgeon would be less than significant and no mitigation would be required.

17 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
18 **White Sturgeon**

19 In general, Alternative 4 would not affect spawning and egg incubation habitat for white sturgeon  
20 relative to the NAA. Alternative 4 would provide flow-related benefits to green sturgeon spawning in  
21 the Feather River.

22 **H3/ESO**

23 ***Sacramento River***

24 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
25 May spawning and egg incubation period for white sturgeon. Flows at Wilkins Slough and Verona  
26 during February through April under H3 would generally be similar to those under NAA (Appendix  
27 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May at both locations would  
28 generally be greater than flows under NAA.

29 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
30 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
31 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
32 be no differences (<5%) in mean monthly water temperature between NAA and H3 in any month or  
33 water year type throughout the period.

34 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
35 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
36 of the 82-year modeling period (Table 11-4-13). The combination of number of days and degrees  
37 above each threshold were further assigned a “level of concern”, as defined in Table 11-4-14.

38 Differences between baselines and H3 in the highest level of concern across all months and all 82

1 modeled years are presented in Table 11-4-107. For the 61°F threshold, there would be 11 fewer  
2 (19% fewer) “red” years under H3 than under NAA. For the 68°F threshold, there would be  
3 negligible differences in the number of years under each level of concern between NAA and H3.

4 **Table 11-4-107. Differences between Baselines and H3 Scenarios in the Number of Years in Which**  
5 **Water Temperature Exceedances above the 61°F and 68°F Thresholds Are Within Each Level of**  
6 **Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>61°F threshold</b>		
Red	38 (475%)	-11 (-19%)
Orange	-4 (-27%)	-1 (-8%)
Yellow	-13 (-42%)	8 (80%)
None	-21 (-75%)	4 (133%)
<b>68°F threshold</b>		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	1 (NA)	-2 (-200%)
None	-1 (-1%)	2 (2%)

NA = could not be calculated because the denominator was 0.

7  
8 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
9 Hamilton City during March through June (Table 11-4-108, Table 11-4-109). Total degree-days  
10 exceeding the 61°F threshold under H3 would be 1 degree-day (6%) greater than those during  
11 March, which would not be biologically meaningful. During April through June, total degree days  
12 above 61°F would be 41 to 774 (9% to 16%) lower under H3 than under NAA. Total degree-days  
13 exceeding the 68°F threshold be similar between NAA and H3, except during May, in which  
14 exceedances would be 20 degree-days (30%) fewer under H3.

1 **Table 11-4-108. Differences between Baseline and H3 Scenarios in Total Degree-Days (°F-Days) by**  
 2 **Month and Water Year Type for Water Temperature Exceedances above 61°F in the Sacramento**  
 3 **River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	5 (NA)	1 (25%)
	Dry	11 (NA)	0 (0%)
	Critical	1 (NA)	0 (0%)
	All	17 (NA)	1 (6%)
April	Wet	65 (542%)	-1 (-1%)
	Above Normal	59 (590%)	-9 (-12%)
	Below Normal	62 (1,033%)	0 (0%)
	Dry	113 (222%)	-31 (-16%)
	Critical	14 (1,400%)	0 (0%)
	All	313 (391%)	-41 (-9%)
May	Wet	990 (297%)	-125 (-9%)
	Above Normal	223 (102%)	-128 (-22%)
	Below Normal	380 (207%)	-69 (-11%)
	Dry	247 (122%)	-186 (-29%)
	Critical	368 (182%)	18 (3%)
	All	2,208 (194%)	-490 (-13%)
June	Wet	639 (111%)	-319 (-21%)
	Above Normal	124 (41%)	-242 (-36%)
	Below Normal	364 (173%)	-138 (-19%)
	Dry	578 (173%)	-124 (-12%)
	Critical	595 (159%)	49 (5%)
	All	2,300 (128%)	-774 (-16%)

NA = could not be calculated because the denominator was 0.

4

1 **Table 11-4-109. Differences between Baseline and H3 Scenarios in Total Degree-Days (°F-Days) by**  
 2 **Month and Water Year Type for Water Temperature Exceedances above 68°F in the Sacramento**  
 3 **River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Mar	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
Apr	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
May	Wet	35 (500%)	-1 (-2%)
	Above Normal	1 (NA)	-19 (-95%)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	-2 (-100%)
	Critical	2 (NA)	1 (100%)
	All	39 (557%)	-20 (-30%)
Jun	Wet	7 (NA)	-1 (-13%)
	Above Normal	1 (100%)	-3 (-60%)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	13 (NA)	-14 (-52%)
	All	23 (2,300%)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento  
 7 River were examined during the February to May spawning and egg incubation period for white  
 8 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito  
 9 Afterbay under H3 would generally be greater by up to 59% than those under NAA, with some  
 10 exceptions. Flows at the confluence with the Sacramento River under H3 would be similar to or  
 11 greater than flows under NAA, with some exceptions.

12 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
 13 confluence with the Sacramento River were examined during the February through May white  
 14 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ  
 15 between NAA and H3 at either location throughout the period.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis under H3 during February through May would not be  
3 different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 Water temperature modeling was not conducted for the San Joaquin River.

5 **H1/LOS**

6 **Sacramento River**

7 Flows under H1 in the Sacramento River at Wilkins Slough and Verona during February to May  
8 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
9 *Fish Analysis*).

10 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
11 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
12 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
13 be no differences (<5%) in mean monthly water temperature between NAA and H1 in any month or  
14 water year type throughout the period.

15 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
16 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
17 of the 82-year modeling period (Table 11-4-13). The combination of number of days and degrees  
18 above each threshold were further assigned a “level of concern”, as defined in Table 11-4-14.

19 Differences between baselines and H1 in the highest level of concern across all months and all 82  
20 modeled years are presented in Table 11-4-110. For the 61°F threshold, there would be 11 fewer  
21 (19% fewer) “red” years under H1 than under NAA. For the 68°F threshold, there would be  
22 negligible differences in the number of years under each level of concern between NAA and H1.

23 **Table 11-4-110. Differences between Baselines and H1 and H4 Scenarios in the Number of Years in**  
24 **Which Water Temperature Exceedances above the 61°F and 68°F Thresholds Are within Each Level**  
25 **of Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. H1	NAA vs. H1	EXISTING CONDITIONS vs. H4	NAA vs. H4
<b>61°F threshold</b>				
Red	38 (475%)	-11 (-19%)	51 (638%)	2 (4%)
Orange	-3 (-20%)	0 (0%)	-4 (-27%)	-1 (-8%)
Yellow	-16 (-52%)	5 (50%)	-23 (-74%)	-2 (-20%)
None	-19 (-68%)	6 (200%)	-24 (-86%)	1 (33%)
<b>68°F threshold</b>				
Red	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)	0 (NA)	0 (NA)
Yellow	1 (NA)	-2 (-67%)	2 (NA)	-1 (-33%)
None	-1 (-1%)	2 (3%)	-2 (-2%)	1 (1%)

NA = could not be calculated because the denominator was 0.

1 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
 2 Hamilton City during March through June (Table 11-4-111, Table 11-4-112). Total degree-days  
 3 exceeding the 61°F threshold under H1 would be 5 degree-days (31%) greater than those during  
 4 March, which would not be biologically meaningful. During April, degree-days would be similar  
 5 between NAA and H1. During May through June, total degree-days above 61°F would be 533 to 801  
 6 (14% to 16%) lower under H1 than under NAA. Total degree-days exceeding the 68°F threshold be  
 7 similar between NAA and H3, except during May and June, in which exceedances would be 21 and  
 8 18 degree-days (32% and 43%, respectively) fewer under H1.

9 **Table 11-4-111. Differences between Baselines and H1 and H4 Scenarios in Total Degree-Days**  
 10 **(°F-days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the**  
 11 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
March	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	9 (NA)	5 (125%)	8 (NA)	4 (100%)
	Dry	11 (NA)	0 (0%)	12 (NA)	1 (9%)
	Critical	1 (NA)	0 (0%)	1 (NA)	0 (0%)
	All	21 (NA)	5 (31%)	21 (NA)	5 (31%)
April	Wet	65 (542%)	-1 (-1%)	67 (558%)	1 (1%)
	Above Normal	62 (620%)	-6 (-8%)	59 (590%)	-9 (-12%)
	Below Normal	62 (1,033%)	0 (0%)	63 (1,050%)	1 (1%)
	Dry	137 (269%)	-7 (-4%)	150 (294%)	6 (3%)
	Critical	13 (1,300%)	-1 (-7%)	14 (1,400%)	0 (0%)
	All	339 (424%)	-15 (-3%)	353 (441%)	-1 (-0.2%)
May	Wet	961 (289%)	-154 (-11%)	1,042 (313%)	-73 (-5%)
	Above Normal	253 (116%)	-98 (-17%)	287 (132%)	-64 (-11%)
	Below Normal	374 (203%)	-75 (-12%)	466 (253%)	17 (3%)
	Dry	219 (108%)	-214 (-34%)	407 (201%)	-26 (-4%)
	Critical	358 (177%)	8 (1%)	341 (168.8%)	-9 (-2%)
	All	2,165 (190%)	-533 (-14%)	2,543 (223%)	-155 (-4%)
June	Wet	595 (103%)	-363 (-24%)	872 (151%)	-86 (-6%)
	Above Normal	144 (47%)	-222 (-33%)	404 (132%)	38 (6%)
	Below Normal	334 (158%)	-168 (-24%)	536 (254%)	34 (5%)
	Dry	547 (163%)	-155 (-15%)	733 (219%)	31 (3%)
	Critical	653 (175%)	107 (11.6%)	620 (166%)	74 (8%)
	All	2,273 (126%)	-801 (-16%)	3,165 (176%)	91 (2%)

NA = could not be calculated because the denominator was 0.

12

1 **Table 11-4-112. Differences between Baselines and H1 and H4 Scenarios in Total Degree-Days**  
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the**  
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING		EXISTING	
		CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
March	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
April	Wet	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)	0 (NA)	0 (NA)
May	Wet	33 (471%)	-3 (-7%)	33 (471%)	-3 (-7%)
	Above Normal	2 (NA)	-18 (-90%)	20 (NA)	0 (0%)
	Below Normal	1 (NA)	1 (NA)	0 (NA)	0 (NA)
	Dry	0 (NA)	-2 (-100%)	3 (NA)	1 (50%)
	Critical	2 (NA)	1 (100%)	2 (NA)	1 (100%)
	All	38 (543%)	-21 (-32%)	58 (829%)	-1 (-2%)
June	Wet	7 (NA)	-1 (-13%)	8 (NA)	0 (0%)
	Above Normal	2 (200%)	-2 (-40%)	4 (400%)	0 (0%)
	Below Normal	1 (NA)	-1 (-50%)	3 (NA)	1 (50%)
	Dry	0 (NA)	0 (NA)	0 (NA)	0 (NA)
	Critical	13 (NA)	-14 (-52%)	7 (NA)	-20 (-74%)
	All	23 (2,300%)	-18 (-43%)	22 (2,200%)	-19 (-45%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 Flows under H1 in the Feather River between Thermalito Afterbay and the confluence with the  
 7 Sacramento River during the February to May would generally be similar to flows under H3 with  
 8 few exceptions.

9 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
 10 confluence with the Sacramento River were examined during the February through May white  
 11 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ  
 12 between NAA and H1 at either location throughout the period.

13 **San Joaquin River**

14 Flows under H1 in the San Joaquin River would be the same as those under H3.

15 Water temperature modeling was not conducted for the San Joaquin River.

1 **H4/HOS**

2 ***Sacramento River***

3 Flows under H4 in the Sacramento River at Wilkins Slough and Verona during February to May  
4 would generally be similar to or greater than flows under H3 with few exceptions (Appendix 11C,  
5 *CALSIM II Model Results utilized in the Fish Analysis*).

6 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
7 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
8 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
9 be no differences (<5%) in mean monthly water temperature between NAA and H4 in any month or  
10 water year type throughout the period.

11 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
12 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
13 of the 82-year modeling period (Table 11-4-13). The combination of number of days and degrees  
14 above each threshold were further assigned a “level of concern”, as defined in Table 11-4-14.  
15 Differences between baselines and H4 in the highest level of concern across all months and all 82  
16 modeled years are presented in Table 11-4-110. For the 61°F threshold, there would be 2 more  
17 (4%) “red” years under H4 than under NAA, which would not be biologically meaningful. For the  
18 68°F threshold, there would be negligible differences in the number of years under each level of  
19 concern between NAA and H4.

20 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
21 Hamilton City during March through June (Table 11-4-111, Table 11-4-112). Total degree-days  
22 exceeding the 61°F threshold under H4 would be 5 degree-days (31%) greater than those during  
23 March, which would not be biologically meaningful. During the remaining months, there would be  
24 no differences between NAA and H4 in total degree-days exceeding the 61°F threshold. Total  
25 degree-days exceeding the 68°F threshold be similar between NAA and H4, except during June, in  
26 which exceedances would be 19 degree-days (45%) fewer under H4.

27 ***Feather River***

28 Flows under H4 in the Feather River between Thermalito Afterbay and the confluence with the  
29 Sacramento River during the February to May would generally be similar to or greater than flows  
30 under H3 with few exceptions.

31 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
32 confluence with the Sacramento River were examined during the February through May white  
33 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ  
34 between NAA and H4 at either location throughout the period.

35 ***San Joaquin River***

36 Mean monthly flows in the San Joaquin River at Vernalis under H4 during February through May  
37 would be similar to those under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
38 *Analysis*).

39 Water temperature modeling was not conducted for the San Joaquin River.

1 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not  
2 have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 4  
3 would generally be higher in the Feather River under Alternative 4 relative to the NAA and generally  
4 similar to flows under the NAA in the Sacramento and San Joaquin Rivers. Alternative 4 would not  
5 affect temperatures in any river during the white sturgeon spawning and egg incubation period.  
6 Results would generally be similar among model scenarios

7 **CEQA Conclusion:** In general, Alternative 4 would not reduce spawning and egg incubation habitat  
8 for white sturgeon relative to Existing Conditions.

### 9 **Sacramento River**

10 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to  
11 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results*  
12 *utilized in the Fish Analysis*). At Wilkins Slough, flows under H3 during February through April would  
13 be similar to those under Existing Conditions with few exceptions, and greater by up to 28% than  
14 flows under Existing Conditions during May with few exceptions. At Verona, flows under H3 during  
15 February would be generally lower by up to 9% than flows under Existing Conditions with few  
16 exceptions. Flows under H3 during March and April would generally be similar to flows under  
17 Existing Conditions with few exceptions. Flows under H3 during May would generally be greater by  
18 up to 18% than flows under Existing Conditions with few exceptions.

19 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
20 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*  
21 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
22 be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in  
23 any month or water year type throughout the period, except for a 5% increase in wet years during  
24 May.

25 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
26 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
27 of the 82-year modeling period (Table 11-4-13). The combination of number of days and degrees  
28 above each threshold were further assigned a “level of concern”, as defined in Table 11-4-14.  
29 Differences between baselines and H3 in the highest level of concern across all months and all 82  
30 modeled years are presented in Table 11-4-107. For the 61°F threshold, there would be 38 more  
31 (475% increase) “red” years under H3 than under Existing Conditions. For the 68°F threshold, there  
32 would be negligible differences in the number of years under each level of concern between Existing  
33 Conditions and H3.

34 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
35 Hamilton City during March through June (Table 11-4-108, Table 11-4-109). Total degree-days  
36 exceeding the 61°F threshold under H3 would be 17 degree-days (percent change unable to be  
37 calculated due to division by 0) to 2,300 degree-days (128%) higher depending on month. Total  
38 degree-days exceeding the 68°F threshold would not differ between Existing Conditions and H3  
39 during March and April. During May and June, total degree-days would be 39 (557%) and 23  
40 (2,300%) degree-days higher under H3, although these small absolute differences would not cause a  
41 biologically meaningful effect on white sturgeon.

1 **Feather River**

2 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento  
3 River were examined during the February to May spawning and egg incubation period for white  
4 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito  
5 Afterbay under H3 during February would generally be lower by up to 45% than flows under  
6 Existing Conditions with few exceptions, and flows during March through May would generally be  
7 greater by up to 131% than those under Existing Conditions, with few exceptions. Flows at the  
8 confluence with the Sacramento River under H3 would generally be similar to or greater than flows  
9 under Existing Conditions, except in below normal years during February and March (11% and 20%  
10 lower, respectively) and wet years during May (26% lower). These results indicate that there would  
11 be few reductions in flows in the Feather River under H3 relative to Existing Conditions.

12 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
13 confluence with the Sacramento River were examined during the February through May white  
14 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality  
15 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
16 temperatures would not differ between Existing Conditions and H3 at either location throughout the  
17 period, except below Thermalito Afterbay during February, in which temperatures under H3 would  
18 be 6% higher than temperatures under Existing Conditions.

19 **San Joaquin River**

20 Mean monthly flows in the San Joaquin River at Vernalis under H3 during February through May  
21 would be similar to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized  
22 in the Fish Analysis*).

23 Water temperature modeling was not conducted for the San Joaquin River.

24 **H1/LOS**

25 **Sacramento River**

26 Flows under H1 in the Sacramento River at Wilkins Slough and Verona during the February through  
27 May white sturgeon spawning period would generally be similar to flows under H3 (Appendix 11C,  
28 *CALSIM II Model Results utilized in the Fish Analysis*).

29 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
30 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water  
31 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
32 be no differences (<5%) in mean monthly water temperature between Existing Conditions and H1 in  
33 any month or water year type throughout the period, except for a 5% increase in wet years during  
34 May.

35 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
36 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year  
37 of the 82-year modeling period (Table 11-4-13). The combination of number of days and degrees  
38 above each threshold were further assigned a “level of concern”, as defined in Table 11-4-14.  
39 Differences between baselines and H1 in the highest level of concern across all months and all 82  
40 modeled years are presented in Table 11-4-110. For the 61°F threshold, there would be 38 more  
41 (475% increase) “red” years under H1 than under Existing Conditions. For the 68°F threshold, there

1 would be negligible differences in the number of years under each level of concern between Existing  
2 Conditions and H1.

3 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
4 Hamilton City during March through June (Table 11-4-108, Table 11-4-109). Total degree-days  
5 exceeding the 61°F threshold under H3 would be 21 degree-days (percent change unable to be  
6 calculated due to division by 0) to 2,273 degree-days (126%) higher depending on month. Total  
7 degree-days exceeding the 68°F threshold would not differ between Existing Conditions and H1  
8 during March and April. During May and June, total degree-days would be 38 (543%) and 23  
9 (2,300%) degree-days higher under H1, although these small absolute differences would not cause a  
10 biologically meaningful effect on white sturgeon.

### 11 **Feather River**

12 Flows under H1 in the Feather River between Thermalito Afterbay and the confluence with the  
13 Sacramento River during the February to May would generally be similar to flows under H3 with  
14 few exceptions.

15 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
16 confluence with the Sacramento River were examined during the February through May white  
17 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality  
18 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
19 temperatures would not differ between Existing Conditions and H1 at either location throughout the  
20 period, except below Thermalito Afterbay during February, in which temperatures under H1 would  
21 be 6% higher than temperatures under Existing Conditions.

### 22 **San Joaquin River**

23 Flows under H1 in the San Joaquin River would be the same as those under H3.

24 Water temperature modeling was not conducted for the San Joaquin River.

25 Results of these analyses for H1 would be the same as those for H3. Overall, results for H1 would be  
26 similar to those under H3.

## 27 **H4/HOS**

### 28 **Sacramento River**

29 Flows under H4 in the Sacramento River at Wilkins Slough and Verona during February to May  
30 would generally be similar to or greater than flows under H3 with few exceptions (Appendix 11C,  
31 *CALSIM II Model Results utilized in the Fish Analysis*).

32 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
33 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water  
34 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
35 be no differences (<5%) in mean monthly water temperature between Existing Conditions and H1 in  
36 any month or water year type throughout the period, except for a 5% increase in wet years during  
37 May.

38 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by  
39 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year

1 of the 82-year modeling period (Table 11-4-13). The combination of number of days and degrees  
2 above each threshold were further assigned a “level of concern”, as defined in Table 11-4-14.  
3 Differences between baselines and H1 in the highest level of concern across all months and all 82  
4 modeled years are presented in Table 11-4-110. For the 61°F threshold, there would be 38 more  
5 (475% increase) “red” years under H1 than under Existing Conditions. For the 68°F threshold, there  
6 would be negligible differences in the number of years under each level of concern between Existing  
7 Conditions and H1.

8 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at  
9 Hamilton City during March through June (Table 11-4-108, Table 11-4-109). Total degree-days  
10 exceeding the 61°F threshold under H3 would be 21 degree-days (percent change unable to be  
11 calculated due to division by 0) to 2,273 degree-days (126%) higher depending on month. Total  
12 degree-days exceeding the 68°F threshold would not differ between Existing Conditions and H1  
13 during March and April. During May and June, total degree-days would be 38 (543%) and 23  
14 (2,300%) degree-days higher under H1, although these small absolute differences would not cause a  
15 biologically meaningful effect on white sturgeon.

### 16 ***Feather River***

17 Flows under H4 in the Feather River between Thermalito Afterbay and the confluence with the  
18 Sacramento River during the February to May would generally be similar to or greater than flows  
19 under H3 with few exceptions.

20 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the  
21 confluence with the Sacramento River were examined during the February through May white  
22 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality  
23 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
24 temperatures would not differ between Existing Conditions and H4 at either location throughout the  
25 period, except below Thermalito Afterbay during February, in which temperatures under H4 would  
26 be 6% higher than temperatures under Existing Conditions.

### 27 ***San Joaquin River***

28 Flows under H4 in the San Joaquin River would be the same as those under H3.

29 Results of these analyses for H4 would be the same as those for H3. Overall, results for H4 would be  
30 similar to those under H3.

### 31 **Summary of CEQA Conclusion**

32 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between  
33 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
34 alternative could substantially reduce the amount of suitable spawning and egg incubation habitat  
35 for white sturgeon, contrary to the NEPA conclusion set forth above. There are small, infrequent  
36 reductions in flows in the Sacramento and Feather rivers that would not cause biologically  
37 meaningful effects to white sturgeon spawning and egg incubation habitat. However, there would be  
38 differences in exceedances of NMFS temperature thresholds in the Sacramento and Feather River  
39 that would cause a biologically meaningful effect to white sturgeon spawning and egg incubation.  
40 Results would generally be consistent among scenarios.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and H3 indicates that flows in the locations and during the months  
14 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
15 indicates that the differences between Existing Conditions and Alternative 4 found above would  
16 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
17 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
18 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
19 impact on spawning habitat for white sturgeon. This impact is found to be less than significant and  
20 no mitigation is required.

### 21 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

22 In general, Alternative 4 would not affect quantity and quality of white sturgeon larval and juvenile  
23 rearing habitat relative to the NAA.

#### 24 **H3/ESO**

25 Water temperature was used to determine the potential effects of H3 on white sturgeon larval and  
26 juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their  
27 habitat is more likely to be limited by changes in water temperature than flow rates.

28 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
29 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water  
30 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
31 be no differences (<5%) in mean monthly water temperature between NAA and H3 in any month or  
32 water year type throughout the period.

33 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
34 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality  
35 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
36 differences (<5%) in mean monthly water temperature between NAA and H3 in any month or water  
37 year type throughout the period.

38 Water temperatures were not modeled in the San Joaquin River.

#### 39 **H1/LOS**

40 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
41 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*

1 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
2 be no differences (<5%) in mean monthly water temperature between NAA and H1 in any month or  
3 water year type throughout the period.

4 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
5 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality*  
6 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
7 differences (<5%) in mean monthly water temperature between NAA and H1 in any month or water  
8 year type throughout the period.

9 Water temperatures were not modeled in the San Joaquin River.

#### 10 **H4/HOS**

11 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
12 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
13 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would  
14 be no differences (<5%) in mean monthly water temperature between NAA and H4 in any month or  
15 water year type throughout the period.

16 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
17 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality*  
18 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no  
19 differences (<5%) in mean monthly water temperature between NAA and H4 in any month or water  
20 year type throughout the period.

21 Water temperatures were not modeled in the San Joaquin River.

22 **NEPA Effects:** These results indicate that the effect is not adverse because it does not have the  
23 potential to substantially reduce the amount of suitable habitat. There would be no differences in  
24 water temperatures between Alternative 4 and the NEPA point of comparison. Results would be  
25 similar among scenarios.

26 **CEQA Conclusion:** In general, Alternative 4 would not affect the quantity and quality of white  
27 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

#### 28 **H3/ESO**

29 Water temperature was used to determine the potential effects of H3 on white sturgeon larval and  
30 juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their  
31 habitat is more likely to be limited by changes in water temperature than flow rates.

32 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
33 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*  
34 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
35 monthly water temperatures would be similar between Existing Conditions and H3 during  
36 November through July and September, but 6% and 5% higher under H3 relative to Existing  
37 Conditions during August and October, respectively.

38 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
39 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality*  
40 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water

1 temperatures would be similar between Existing Conditions and H3 during March through July and  
2 September, but 5% to 8% higher under H3 relative to Existing Conditions during October through  
3 February and August.

4 Water temperatures were not modeled in the San Joaquin River.

#### 5 **H1/LOS**

6 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
7 the year-round white sturgeon juvenile rearing period (*Appendix 11D, Sacramento River Water  
8 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
9 monthly water temperatures would be similar between Existing Conditions and H1 during  
10 November through July and September, but 6% and 7% higher under H1 relative to Existing  
11 Conditions during August and September, respectively.

12 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
13 year-round white sturgeon juvenile rearing period (*Appendix 11D, Sacramento River Water Quality  
14 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
15 temperatures would be similar between Existing Conditions and H1 during March through July and  
16 September, but 5% to 8% higher under H1 relative to Existing Conditions during October through  
17 February and August.

18 Water temperatures were not modeled in the San Joaquin River.

#### 19 **H4/HOS**

20 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during  
21 the year-round white sturgeon juvenile rearing period (*Appendix 11D, Sacramento River Water  
22 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean  
23 monthly water temperatures would be similar between Existing Conditions and H4 during  
24 November through July and September, but 5% higher under H4 relative to Existing Conditions  
25 during August and October.

26 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the  
27 year-round white sturgeon juvenile rearing period (*Appendix 11D, Sacramento River Water Quality  
28 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water  
29 temperatures would be similar between Existing Conditions and H4 during March through June and  
30 September, but 6% to 8% higher under H4 relative to Existing Conditions during October through  
31 February and July through August.

32 Water temperatures were not modeled in the San Joaquin River.

#### 33 **Summary of CEQA Conclusion**

34 These results indicate that the effect is less than significant because it does not have the potential to  
35 substantially reduce the amount of suitable habitat and no mitigation is required. There would be no  
36 differences in water temperatures between Alternative 4 and the CEQA baseline. Results would be  
37 similar among scenarios.

1 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

2 In general, effects of Alternative 4 on white sturgeon migration conditions relative to NAA are  
3 uncertain.

4 **Upstream of the Delta**

5 **H3/ESO**

6 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins  
7 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number  
8 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)  
9 (Table 11-4-113). Exceedances of the 17,700 cfs threshold for Wilkins Slough and the 31,000 cfs  
10 threshold at Verona under H3 would generally be similar to those under NAA. Despite some large  
11 relative difference (up to 50%), these changes would be negligible on an absolute scale.

12 **Table 11-4-113. Difference and Percent Difference in Number of Months in Which Flow Rates**  
13 **Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>Wilkins Slough, 17,700 cfs<sup>a</sup></b>		
Wet	0 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (5%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
<b>Wilkins Slough, 5,300 cfs<sup>b</sup></b>		
Wet	-0.2 (-3%)	0 (0%)
Above Normal	-0.3 (-4%)	0.1 (1%)
Below Normal	0.3 (5%)	0.6 (12%)
Dry	0.4 (9%)	0.2 (3%)
Critical	0.2 (5%)	0.1 (2%)
<b>Verona, 31,000 cfs<sup>a</sup></b>		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.2 (-10%)	0 (0%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.2 (-60%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Months analyzed: February through May.

<sup>b</sup> Months analyzed: November through May.

14  
15 Larval transport flows were also examined by utilizing the positive correlation between year class  
16 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the  
17 mechanism responsible for the relationship is that Delta outflow provides improved larval transport  
18 that results in improved year class strength. The percentage of months exceeding flow thresholds  
19 under H3 would generally be lower than those under NAA (up to 50% lower) (Table 11-4-114).

1 These results indicate that, using the positive correlation between Delta outflow and year class  
2 strength, year class strength generally would be lower under H3.

3 **Table 11-4-114. Difference and Percent Difference in Percentage of Months in Which Average**  
4 **Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in**  
5 **April and May of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>April</b>			
15,000 cfs	Wet	-8 (-8%)	-8 (-8%)
	Above Normal	-17 (-18%)	-17 (-18%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)
	Above Normal	-25 (-33%)	-17 (-25%)
25,000 cfs	Wet	-15 (-19%)	-12 (-15%)
	Above Normal	-17 (-29%)	-8 (-17%)
<b>May</b>			
15,000 cfs	Wet	-8 (-9%)	0 (0%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-35 (-41%)	-12 (-19%)
	Above Normal	-17 (-40%)	-8 (-25%)
25,000 cfs	Wet	-27 (-39%)	-15 (-27%)
	Above Normal	-17 (-50%)	-8 (-33%)
<b>April/May Average</b>			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-25 (-25%)	-17 (-18%)
20,000 cfs	Wet	-19 (-22%)	-15 (-18%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-25 (-50%)	-25 (-50%)

6  
7 For juveniles, flows in the Sacramento River at Verona were examined during the year-round  
8 migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at  
9 Verona under H3 would be lower by up to 25% relative to NAA during January, July, August, and  
10 November, greater by up to 32% greater during May and June, and similar in the remaining six  
11 months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 For adults, the average number of months per year during the November through May adult  
13 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was  
14 determined (Table 11-4-113). The average number of months exceeding 5,300 cfs under H3 would  
15 be similar to or greater than the number of months under NAA (up to 12% greater).

16 **H1/LOS**

17 Year-round flows under H1 in the Sacramento River at Wilkins Slough and Verona would be similar  
18 to those under H3, except during November at Wilkins Slough in which flows would be up to 13%  
19 lower under H1 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These

1 reductions would not be frequent or large enough to have biologically meaningful effects on white  
2 sturgeon migration in the Sacramento River. Because flows under H1 in the Sacramento River would  
3 be similar to those under H3, additional flow threshold analyses were not warranted. Results of  
4 these analyses for H1 would be the same as those for H3. Overall, results for H1 would be similar to  
5 those for H3.

#### 6 **H4/HOS**

7 Year-round flows under H1 in the Sacramento River at Wilkins Slough and Verona would be similar  
8 to those under H3, except during May and June at Wilkins Slough (up to 21% lower) and during June  
9 through August at Verona (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
10 *Fish Analysis*). These reductions would not be frequent or large enough to have biologically  
11 meaningful effects on white sturgeon migration in the Sacramento River. Because flows under H4 in  
12 the Sacramento River would be similar to those under H3, additional flow threshold analyses were  
13 not warranted. Results of these analyses for H4 would be the same as those for H3. Overall, results  
14 for H4 would be similar to those for H3.

#### 15 **Through-Delta**

16 The impact of Alternative 4 on in-Delta movement conditions would be the same as described above  
17 for splittail (Impact AQUA-114). The effect on white sturgeon would not be adverse.

18 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 4 and  
19 NAA (Table 11-4-113). However, due to the removal of water at the North Delta intakes, there are  
20 substantial differences in through-Delta flows between Alternative 4 and NAA (Table 11-4-114).  
21 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between  
22 year class strength and Delta outflow during April and May. However, this conclusion was reached in  
23 the absence of north Delta intakes and the exact mechanism that causes this correlation is not  
24 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper  
25 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another  
26 hypothesis suggests that the positive correlation is a result of higher flows through the Delta  
27 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some  
28 combination of these factors are working together to produce the positive correlation between high  
29 flows and sturgeon year-class strength.

30 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation  
31 between year class strength and river/Delta flow will be addressed through targeted research and  
32 monitoring to be conducted in the years leading up to the initiation of north Delta facilities  
33 operations. If these targeted investigations determine that the primary mechanisms behind the  
34 positive correlation between high flows and sturgeon year-class strength are related to upstream  
35 conditions, then Alternative 4 would be deemed Not Adverse due to the similarities in upstream  
36 flow conditions between Alternative 4 and NAA. However, if the targeted investigations lead to a  
37 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and  
38 through-Delta flow conditions, then Alternative 4 would be deemed adverse due to the magnitude of  
39 reductions in through-Delta flow conditions in Alternative 4 as compared to NAA.

40 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, migration  
41 conditions for white sturgeon would not be affected relative to the CEQA baseline.

1 **Upstream of the Delta**

2 **H3/ESO**

3 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough  
4 under H3 would generally be similar to or greater those under Existing Conditions, except in below  
5 normal years (25% lower)(Table 11-4-113). The number of months per year exceeding 31,000 cfs at  
6 Verona under H3 would generally be up to 60% lower than those under Existing Conditions except  
7 in critical years, in which there would be no change from Existing Conditions.

8 For Delta outflow, the percent of months exceeding outflow thresholds under H3 would consistently  
9 be lower than those under Existing Conditions for each flow threshold, water year type, and month  
10 (8% to 50% lower on a relative scale) (Table 11-4-114).

11 For juveniles, flows in the Sacramento River at Verona were examined during the year-round  
12 migration period. In general, flows under H3 would be lower relative to Existing Conditions during  
13 January, February, July, August, and November (up to 29% lower), greater during May and June (up  
14 to 33% greater), and similar during the remaining five months (Appendix 11C, *CALSIM II Model*  
15 *Results utilized in the Fish Analysis*).

16 For adult migration, the average number of months exceeding 5,300 cfs at Wilkins Slough under H3  
17 would generally be greater than the number of months under Existing Conditions (up to 9%  
18 greater), except in wet and above normal water years, in which exceedances would be similar  
19 between H3 and Existing Conditions (Table 11-4-113).

20 **H1/LOS**

21 Year-round flows under H1 in the Sacramento River at Wilkins Slough and Verona would be similar  
22 to those under H3, except during November at Wilkins Slough in which flows would be up to 13%  
23 lower under H1 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These  
24 reductions would not be frequent or large enough to have biologically meaningful effects on white  
25 sturgeon migration in the Sacramento River. Because flows under H1 in the Sacramento River would  
26 be similar to those under H3, additional flow threshold analyses were not warranted. Results of  
27 these analyses for H1 would be the same as those for H3. Overall, results for H1 would be similar to  
28 those for H3.

29 **H4/HOS**

30 Year-round flows under H4 in the Sacramento River at Wilkins Slough and Verona would be similar  
31 to those under H3, except during May and June at Wilkins Slough (up to 21% lower) and during June  
32 through August at Verona (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
33 *Fish Analysis*). These reductions would not be frequent or large enough to have biologically  
34 meaningful effects on white sturgeon migration in the Sacramento River. Because flows under H4 in  
35 the Sacramento River would be similar to those under H3, additional flow threshold analyses were  
36 not warranted. Results of these analyses for H4 would be the same as those for H3. Overall, results  
37 for H4 would be similar to those for H3.

38 **Through-Delta**

39 As described above in Impact AQUA-150, the potential impact of Alternative 4 on white sturgeon is  
40 considered less than significant, and no mitigation would be required.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between  
3 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
4 alternative could substantially reduce migration conditions for green sturgeon, contrary to the  
5 NEPA conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for  
6 Delta outflow would be lower under Alternative 4 than under Existing Conditions, although there is  
7 high uncertainty that year class strength is due to Delta outflow or if both year class strength and  
8 Delta outflows are co-variable with another unknown factor. Juvenile migration flows in the  
9 Sacramento River at Verona would be up to 29% lower in five of 12 months relative to Existing  
10 Conditions. These reduced flows would have a substantial effect on the ability to migrate  
11 downstream, delaying or slowing rates of successful migration downstream and increasing the risk  
12 of mortality. There would be no effects of Alternative 4 on through-Delta migration conditions.

13 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
14 change, future water demands, and implementation of the alternative. The analysis described above  
15 comparing Existing Conditions to Alternative 4 does not partition the effect of implementation of the  
16 alternative from those of sea level rise, climate change and future water demands using the model  
17 simulation results presented in this chapter. However, the increment of change attributable to the  
18 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
19 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
20 implementation period, which does include future sea level rise, climate change, and water  
21 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
22 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
23 effect of the alternative from those of sea level rise, climate change, and water demands.

24 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
25 term implementation period and Alternative 4 indicates that flows in the locations and during the  
26 months analyzed above would generally be similar between Existing Conditions during the LLT and  
27 Alternative 4. This indicates that the differences between Existing Conditions and Alternative 4  
28 found above would generally be due to climate change, sea level rise, and future demand, and not  
29 the alternative. As a result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea  
30 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would  
31 not in itself result in a significant impact on migration conditions for white sturgeon. Additionally, as  
32 described above in the NEPA Effects statement, further investigation is needed to better understand  
33 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management  
34 would be used to make adjustments to meet the biological goals and objectives. This impact is found  
35 to be less than significant and no mitigation is required.

36 **Restoration Measures (CM2, CM4–CM7, and CM10)**

37 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
38 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
39 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
40 restoration measures described for white sturgeon under Alternative 1A (Impacts AQUA-151  
41 through AQUA-153) also appropriately characterize effects under Alternative 4.

42 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

1 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

2 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**  
3 **Sturgeon**

4 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

5 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms  
6 on white sturgeon are the same for Alternative 4, as those described under Alternative 1A (Impacts  
7 AQUA 151-through AQUA-153). The effects would not be adverse, and would generally be beneficial.  
8 Specifically for AQUA-152, the effects of contaminants on white sturgeon with respect to copper,  
9 ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on white  
10 sturgeon are uncertain.

11 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or  
12 less than significant, and no mitigation is required.

13 **Other Conservation Measures (CM12–CM19 and CM21)**

14 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
15 differences in other conservation-related fish effects are anticipated anywhere in the affected  
16 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
17 effects of other conservation measures described for white sturgeon under Alternative 1A (Impacts  
18 AQUA-154 through AQUA-162) also appropriately characterize effects under Alternative 4.

19 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

20 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

21 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**  
22 **(CM13)**

23 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

24 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**  
25 **(CM15)**

26 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

27 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

28 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

29 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

30 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**  
31 **Sturgeon (CM21)**

32 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms  
33 on white sturgeon are the same as those described under Alternative 1A (Impacts AQUA-154  
34 through AQUA-162). The effects range from no effect, to not adverse, to beneficial.

1 **CEQA Conclusion:** The effects of the nine impact mechanisms listed above range from no impact, to  
2 less than significant, to beneficial, and no mitigation is required.

### 3 **Pacific Lamprey**

#### 4 **Construction and Maintenance of CM1**

##### 5 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

6 The potential effects of construction of the water conveyance facilities on Pacific lamprey would be  
7 similar to those described for Alternative 1A, Impact AQUA-163, except that Alternative 4 would  
8 include three intakes compared to five intakes under Alternative 1A, so the effects would be  
9 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing  
10 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and  
11 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
12 would require 27.3 acres of dredging. Alternative 4 would use five barge locations rather than six as  
13 under Alternative 1A so those effects would also be proportionally less. Additionally, construction  
14 and excavation at Clifton Court Forebay would be done in the dry via installation of cofferdams for  
15 isolation and dewatering of work areas. Implementation of Appendix 3B, *Environmental*  
16 *Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize  
17 adverse effects as described for Alternative 1A. Mitigation measures would also be available to avoid  
18 and minimize potential effects.

19 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163, the effect would not be adverse  
20 for Pacific lamprey.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-163, the impact of the construction  
22 of the water conveyance facilities on Pacific lamprey would not be significant except for  
23 construction noise associated with pile driving. Potential pile driving impacts would be less than  
24 Alternative 1A because only three intakes would be constructed rather than five. Implementation of  
25 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to  
26 less than significant.

##### 27 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 28 **of Pile Driving and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
30 Alternative 1A.

##### 31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
34 Alternative 1A.

##### 35 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

36 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under  
37 Alternative 4 would be the same as those described for Alternative 1A, Impact AQUA-164, except  
38 that only three intakes would need to be maintained under Alternative 4 rather than five under

1 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the impact would not be adverse for  
2 Pacific lamprey.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance  
4 of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation is  
5 required.

## 6 **Water Operations of CM1**

### 7 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

#### 8 **Water Exports**

9 The potential entrainment impacts of Alternative 4 on Pacific lamprey and river lamprey would be  
10 the same as described above for Alternative 1A for operating SWP/CVP south Delta export facilities  
11 and the proposed new SWP/CVP North Delta intakes (Impacts AQUA-165), non-physical barriers at  
12 the entrances to CCF and the DMC (Impacts AQUA-176), and decommissioning agricultural  
13 diversions in ROAs (Impacts AQUA-180). These actions would avoid or reduce potential  
14 entrainment and the effect would not be adverse and may be beneficial.

15 The analysis of Pacific lamprey and river lamprey entrainment at the SWP/CVP south Delta export  
16 facilities is combined because the salvage facilities do not distinguish between the two lamprey  
17 species. Under Scenario H3, average annual entrainment of lamprey at the south Delta export  
18 facilities would be substantially reduced by about 41% (Table 11-4-115) across all year types  
19 compared to the NAA. Entrainment losses would be similar between Scenario H3 and the Scenario  
20 H1, but would be further reduced under Scenario H4 compared to NAA. Therefore, Alternative 4  
21 would not have adverse effects on lamprey.

#### 22 **Predation Associated with Entrainment**

23 Entrainment-related predation loss of lamprey at the south Delta facilities would not be greater  
24 under this Alternative and may be lower due to a reduction in entrainment loss. Conditions under  
25 Scenario H4 would decrease predation loss relative to NAA and Scenario H3, while conditions would  
26 be similar between Scenario H1 and Scenario H3. Predation at the north Delta would be increased  
27 due to the installation of the proposed water export facilities on the Sacramento River. The effect on  
28 lamprey from predation loss at the north Delta facilities is unknown because of the lack of  
29 knowledge about their distribution and population abundances in the Delta.

30 **NEPA Effects:** Overall, it is expected that the effect of predation loss on lamprey under Alternative 4  
31 may be moderate, but would not be adverse.

32 **CEQA Conclusion:** Annual entrainment losses of lamprey would be decreased under Scenario H3 by  
33 43% relative to existing biological conditions. Conditions would be similar between Scenario H3 and  
34 H1, while entrainment would be further decreased under Scenario H4. Lamprey predation loss at  
35 the south Delta facilities would not be increased relative to Existing Conditions and may be  
36 decreased due to reduction entrainment losses. Predation at the north Delta would be increased due  
37 to the installation of the proposed water export facilities on the Sacramento River. The effect on  
38 lamprey from predation loss at the north Delta facilities is unknown because of the lack of  
39 knowledge about their distribution and population abundances in the Delta. Overall, it is expected  
40 that the effect of predation loss on lamprey under Alternative 4 may be moderate, but would be less  
41 than significant.

1 **Table 11-4-115. Lamprey Annual Entrainment Index<sup>a</sup> at the SWP and CVP Salvage Facilities for**  
 2 **Alternative 4 (Scenario H3)**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A4_LLT	NAA vs. A4_LLT
All Years	-1,462 (-43%)	-1,356 (-41%)

<sup>a</sup> Estimated annual number of fish lost, based on non-normalized data.

3

4 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**  
 5 **Pacific Lamprey**

6 In general, Alternative 4 would not affect the quality and quantity of spawning and egg incubation  
 7 habitat for Pacific lamprey relative to the NAA.

8 **H3/ESO**

9 Flow-related impacts to Pacific lamprey spawning habitat were evaluated by estimating effects of  
 10 flow alterations on egg exposure, called redd dewatering risk, and effects on water temperature.  
 11 Rapid reductions in flow can dewater redds leading to mortality. Locations for each river used in the  
 12 dewatering risk analysis were based on available literature, personal conversations with agency  
 13 experts, and spatial limitations of the CALSIM II model, and include the Sacramento River at  
 14 Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at  
 15 Thermalito Afterbay, and the American River at Nimbus Dam and at the confluence with the  
 16 Sacramento River. Pacific lamprey spawn in these rivers between January and August so flow  
 17 reductions during those months have the potential to dewater redds, which could result in  
 18 incomplete development of the eggs to ammocoetes (the larval stage). Water temperature results  
 19 from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of  
 20 water temperatures under all model scenarios in the upper Sacramento, Trinity, Feather, and  
 21 American rivers.

22 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-  
 23 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning  
 24 location suitability characteristics (e.g., depth, velocity, and substrate) of river lamprey are not  
 25 adequately described to employ a more formal analysis such as a weighted usable area analysis.  
 26 Therefore, there is uncertainty that these values represent actual redd dewatering events, and  
 27 results should be treated as rough estimates of flow fluctuations under each model scenario. Results  
 28 were expressed as the number of cohorts exposed to dewatering risk and as a percentage of the total  
 29 number of cohorts anticipated in the river based on the applicable time-frame, January to August.

30 There would be negligible differences between H3 and NAA in exposure to flow reductions in all  
 31 rivers except for a small (6%) increase in the Feather River at Thermalito Afterbay (Table 11-4-  
 32 116). These results indicate that H3 would not have biologically meaningful effects on Pacific  
 33 lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than  
 34 50% in all locations analyzed.

1 **Table 11-4-116. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**  
2 **Cohorts<sup>a</sup>**

Location	EXISTING CONDITIONS vs. H3	NAA vs. H3
Sacramento River at Keswick	20 (36%)	-2 (-3%)
Sacramento River at Red Bluff	20 (37%)	2 (3%)
Trinity River downstream of Lewiston	0 (0%)	0 (0%)
Feather River at Thermalito Afterbay	-36 (-24%)	6 (6%)
American River at Nimbus Dam	32 (38%)	-5 (-4%)
American River at Sacramento River Confluence	34 (36%)	-6 (-4%)

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%. Positive values indicate a higher value in H3 than in Existing Conditions or NAA.

3  
4 Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C  
5 (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the  
6 number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least  
7 one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis  
8 predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C  
9 (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual  
10 day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River,  
11 corresponding to 82 years of eggs being laid every day each year from January 1 through August 31,  
12 and 648 cohorts for the other rivers using monthly data over the same period. The incubation  
13 periods used in this analysis are conservative and represent the extreme long end of the egg  
14 incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited  
15 because the extreme temperatures are masked; however, no better analytical tools are currently  
16 available for this analysis. Exact spawning locations of Pacific lamprey are not well defined.  
17 Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

18 In most locations, egg cohort exposure would not differ between NAA and H3 (Table 11-4-117).  
19 However, the number of cohorts exposed under H3 would be 100% and 93% lower than those  
20 under NAA in the Sacramento River at Keswick and Trinity River at Lewiston, respectively. Also, the  
21 number of cohorts exposed under H3 would be 11% and 53% greater than those under NAA in the  
22 Sacramento River at Hamilton City. The increases and decreases in egg cohort exposure under NAA  
23 would not have a biologically meaningful effect due to their small absolute values relative to total  
24 egg cohort sizes.

1 **Table 11-4-117. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg**  
2 **Cohort Temperature Exposure<sup>a</sup>**

Location	EXISTING CONDITIONS vs. H3	NAA vs. H3
Sacramento River at Keswick	0 (NA)	-51 (-100%)
Sacramento River at Hamilton City	1,186 (NA)	118 (11%)
Trinity River at Lewiston	4 (200%)	-83 (-93%)
Trinity River at North Fork	14 (NA)	-3 (-18%)
Feather River at Fish Barrier Dam	0 (NA)	-1 (-100%)
Feather River below Thermalito Afterbay	117 (488%)	49 (53%)
American River at Nimbus	74 (673%)	0 (0%)
American River at Sacramento River Confluence	158 (282%)	-2 (-1%)
Stanislaus River at Knights Ferry	2 (NA)	0 (0%)
Stanislaus River at Riverbank	87 (4,350%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F during January to August on at least one day during a 49-day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for in other rivers each model scenario. Positive values indicate a higher value in H3 than in EXISTING CONDITIONS or NAA.

3

4 **H1/LOS**

5 Flows during January through August under H1 would generally be similar to or greater than flows  
6 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
7 not conducted for H1 in these rivers and results for H1 would be the same as those for H3.

8 In the Feather River at Thermalito Afterbay, there would be 41 more cohorts (38%) exposed to a  
9 50% month over month drop in flow rate under H1 relative to NAA (Table 11-4-118). Although  
10 relatively large, this value represents 6% of the population of ammocoetes. Therefore, it is not  
11 expected that this increase in exposure would have a biologically meaningful effect to the  
12 population.

13 **Table 11-4-118. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**  
14 **Cohorts in the Feather River at Thermalito Afterbay<sup>a</sup>**

Measurement	EXISTING CONDITIONS vs. H1		EXISTING CONDITIONS vs. H4	
	NAA vs. H1		NAA vs. H4	
Difference (Percent Difference)	-1 (-1%)	41 (38%)	-30 (-20%)	12 (11%)

<sup>a</sup> Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%. Positive values indicate a higher value in H1 or H4 than in Existing Conditions or NAA.

15

16 Water temperatures would not differ between H1 and H3 and, therefore, no egg cohort temperature  
17 analyses were conducted. Overall, results for H1 would be similar to those for H3.

#### 1 H4/HOS

2 Flows during January through August under H4 would generally be similar to or greater than flows  
3 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
4 not conducted for H4 in these rivers and results for H4 would be the same as those for H3.

5 In the Feather River at Thermalito Afterbay, there would be 12 more cohorts (11%) exposed to a  
6 50% month over month drop in flow rate under H4 relative to NAA (Table 11-4-118). Although  
7 relatively large, this value represents <2% of the population of ammocoetes. Therefore, it is not  
8 expected that this increase in exposure would have a biologically meaningful effect to the  
9 population.

10 Water temperatures would not differ between H4 and H3 and, therefore, no egg cohort temperature  
11 analyses were conducted. Overall, results for H4 would be similar to those for H3.

12 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because Alternative 4  
13 would not have substantial effects on spawning and egg incubation habitat for Pacific lamprey.  
14 Flows reductions that increase redd dewatering risk would not differ between the NEPA point of  
15 comparison and H3 in all locations except the in Feather River at Thermalito Afterbay. This result in  
16 the Feather River would be similar for H4 but dewatering risk would be higher under H1. There  
17 would be increases and decreases in exposure risk of eggs to elevated temperatures but would not  
18 have a biologically meaningful effect due to their small absolute values relative to total egg cohort  
19 sizes.

20 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
21 and quality of spawning and egg incubation habitat for Pacific lamprey would not be affected  
22 relative to the CEQA baseline.

#### 23 H3/ESO

24 Effects of H3 on month-over-month flow reduction compared to Existing Conditions consist of  
25 negligible effects (<5% difference) in the Trinity River, a decrease in egg cohorts exposed to flow  
26 reductions (-20%) in the Feather River, and moderate to substantial increases in exposures in the  
27 Sacramento River and American River (Table 11-4-116). Changes would be most substantial for the  
28 American River (increased risk of dewatering exposure to 40 cohorts or 48% at Nimbus Dam, and  
29 44 cohorts or 46% at the confluence). For the Sacramento River, there would be increased exposure  
30 to flow reductions for 12 cohorts or 22% at Keswick, and to 8 cohorts or 15% at Red Bluff. These  
31 results indicate that effects of Alternative 4 on flow would not affect Pacific lamprey redd  
32 dewatering risk in the Feather River and Trinity River; Alternative 4 would affect dewatering risk in  
33 the Sacramento River (increases to 22%) and the American River (increase of 48% at Nimbus Dam  
34 and 46% at the confluence).

35 The number of egg cohorts exposed to 22°C (71.6°F) under H3 would be greater than that under  
36 Existing Conditions in all the river locations, except the Trinity River (Table 11-4-117).

#### 37 H1/LOS

38 Flows during January through August under H1 would generally be similar to or greater than flows  
39 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
40 not conducted for H1 in these rivers and results for H1 would be the same as those for H3.

1 In the Feather River at Thermalito Afterbay, there would be no difference between H1 and Existing  
2 Conditions in the number of cohorts exposed to a 50% month over month drop in flow rate (Table  
3 11-4-118).

4 Water temperatures under H1 would be similar to those under H3 for all rivers examined.  
5 Therefore, no additional cohort temperature exposure analyses were conducted for H1. Overall,  
6 results for H1 would be similar to those for H3 except for redd dewatering risk in the Feather River.

#### 7 **H4/HOS**

8 Flows during January through August under H4 would generally be similar to or greater than flows  
9 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
10 not conducted for H4 in these rivers and results for H4 would be the same as those for H3.

11 In the Feather River at Thermalito Afterbay, there would be 30 fewer cohorts (20%) exposed to a  
12 50% month over month drop in flow rate under H1 relative to NAA (Table 11-4-118). Although  
13 relatively large, this value represents <5% of the population of ammocoetes. Therefore, it is not  
14 expected that this decrease in exposure would have a biologically meaningful effect to the  
15 population.

16 Water temperatures under H4 would be similar to those under H3 for all rivers examined.  
17 Therefore, no additional cohort temperature exposure analyses were conducted for H4. Overall,  
18 results for H4 would be similar to those for H3.

#### 19 **Summary of CEQA Conclusion**

20 Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between  
21 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
22 alternative could substantially reduce suitable spawning habitat and substantially reduce the  
23 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. There  
24 would be moderate increases in redd dewatering in the Sacramento River (up to 22%) and  
25 substantial increases in the American River (up to 48%) that would increase the risk of desiccation  
26 of eggs. There would be a substantial increase (up to 4,350%) in exposure of egg cohorts to elevated  
27 water temperatures in all rivers except the Trinity River that would increase stress and the risk of  
28 mortality.

29 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
30 change, future water demands, and implementation of the alternative. The analysis described above  
31 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
32 alternative from those of sea level rise, climate change and future water demands using the model  
33 simulation results presented in this chapter. However, the increment of change attributable to the  
34 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
35 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
36 implementation period, which does include future sea level rise, climate change, and water  
37 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
38 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
39 effect of the alternative from those of sea level rise, climate change, and water demands.

40 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
41 term implementation period and H3 indicates that flows in the locations and during the months  
42 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This

1 indicates that the differences between Existing Conditions and Alternative 4 found above would  
2 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
3 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
4 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
5 impact on spawning habitat for Pacific lamprey. This impact is found to be less than significant and  
6 no mitigation is required.

### 7 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

8 In general, the effect of Alternative 4 on Pacific lamprey rearing habitat would be negligible relative  
9 to the NAA.

### 10 **H3/ESO**

11 Flow-related impacts to Pacific lamprey rearing habitat were evaluated by estimating of the  
12 frequency of rapid flow reductions in ammocoete rearing areas. Rapid reductions in flow can strand  
13 ammocoetes, leading to mortality. Comparisons of effects were made for ammocoete cohorts in the  
14 Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River  
15 at Nimbus Dam and at the confluence with the Sacramento River. An ammocoete remains relatively  
16 immobile in the sediment in the same location for 5 to 7 years, after which it migrates downstream.  
17 During the upstream rearing period there is potential for ammocoete stranding from rapid  
18 reductions in flow.

19 The analysis of ammocoete stranding was conducted by analyzing a range of month-over-month  
20 flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of  
21 ammocoetes was assumed to be born every month during their spawning period (January through  
22 August) and spend 7 years rearing upstream. Therefore, a cohort was considered stranded if at least  
23 one month-over-month flow reduction was greater than a given flow reduction (50%–90% in 5%  
24 increments) at any time during the seven-year period.

25 Comparisons of month-over-month flow reductions for the Sacramento River at Keswick (Table 11-  
26 4-119) indicate that H3 would have either no effect (0%) or negligible effects (<5%) on cohort  
27 exposures to all flow reductions. These results indicate that there would be no difference in Pacific  
28 lamprey stranding risk between H3 and NAA in the Sacramento River at Keswick.

1 **Table 11-4-119. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**  
 3 **Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	4	0
-65%	3	3
-70%	-2	-2
-75%	-3	0
-80%	7	0
-85%	47	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

4  
 5 Results of comparisons for the Sacramento River at Red Bluff (Table 11-4-120) indicate that there  
 6 would be no or negligible changes in most flow reductions and a moderate decrease (-16%) in  
 7 exposure at the 80% flow reduction, which would be a beneficial effect on rearing conditions. These  
 8 results indicate that there would generally be no or beneficial effects of H3 on Pacific lamprey  
 9 ammocoete in the Sacramento River at Red Bluff.

10 **Table 11-4-120. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
 11 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 12 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	4	0
-60%	6	4
-65%	-2	-3
-70%	9	-2
-75%	0	-9
-80%	6	-16
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

13  
 14 Comparisons for the Trinity River indicate that there would be no differences in cohort exposure  
 15 between NAA and H3 at any flow reduction (Table 11-4-121). These results indicate that there  
 16 would be no effects of H3 on Pacific lamprey stranding risk in the Trinity River.

1 **Table 11-4-121. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	21	-3
-80%	27	0
-85%	18	0
-90%	41	3

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

3

4 In the Feather River at Thermalito Afterbay, there would be no difference in ammocoete cohort  
5 exposure at the 50% through 75% flow reductions (Table 11-4-122). For the 80% through 90% flow  
6 reductions, ammocoete exposure would be 6% to 35% lower, which would have a beneficial effect  
7 on ammocoete rearing. These results indicate that there will be beneficial effects of H3 on Pacific  
8 lamprey ammocoete rearing in the Feather River.

9 **Table 11-4-122. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
11 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-12	-10
-85%	-15	-35
-90%	-53	-6

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

12

13 Comparisons for the American River at Nimbus Dam (Table 11-4-123) and at the confluence with  
14 the Sacramento River (Table 11-4-124) have similar results. There would be no or negligible  
15 differences in cohort exposure between NAA and H3 for the 50% to 70% flow reductions range,  
16 There would be higher cohort exposure under H3 relative to NAA at Nimbus Dam at the 75% flow  
17 reduction (7% higher) and at the confluence with the Sacramento River at the 75% (7% higher) and  
18 80% (17% higher) flow reductions. There would be up to 25% lower cohort exposures under H3

1 relative to NAA at the remaining flow reductions at both locations. These results indicate that there  
2 would generally be no effect of H3 on stranding risk in the American River with few small exceptions  
3 that would not be common enough to have biologically meaningful effects.

4 **Table 11-4-123. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
5 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
6 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	39	-1
-75%	104	7
-80%	200	-21
-85%	352	-11
-90%	125	-25

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

7

8 **Table 11-4-124. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**  
9 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
10 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	7	-1
-75%	45	7
-80%	246	17
-85%	186	-18
-90%	268	-12

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

11

12 To evaluate water temperature-related effects of H3 on Pacific lamprey ammocoetes, we examined  
13 the predicted number of ammocoete “cohorts” that experience water temperatures greater than  
14 71.6°F for at least one day in the Sacramento River (because daily water temperature data are  
15 available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers over a 7  
16 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each individual  
17 day or month starts a new “cohort” such that there are 18,244 cohorts for the Sacramento River,

1 corresponding to 82 years of ammocoetes being “born” every day each year from January 1 through  
2 August 31, and 593 cohorts for the other rivers using monthly data over the same period.

3 There would be differences in the number of ammocoete cohorts exposed to temperatures greater  
4 than 71.6°F in most of the rivers (Table 11-1A-125). However, each river with an increase in  
5 exposure would also have a site with a decrease in exposure. Overall, the increases and decreases  
6 are expected to balance out within rivers such that there would be no overall effect on Pacific  
7 lamprey ammocoetes.

8 **Table 11-4-125. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey**  
9 **Ammocoete Cohorts Exposed to Temperatures Greater than 71.6°F in at Least One Day or Month**

Location	EXISTING CONDITIONS vs. H3	NAA vs. H3
Sacramento River at Keswick <sup>b</sup>	0 (NA)	-1,705 (-100%)
Sacramento River at Hamilton City <sup>b</sup>	13,236 (NA)	1,981 (18%)
Trinity River at Lewiston	136 (NA)	23 (20%)
Trinity River at North Fork	283 (NA)	-22 (-7%)
Feather River at Fish Barrier Dam	0 (NA)	-56 (-100%)
Feather River below Thermalito Afterbay	211 (55%)	72 (14%)
American River at Nimbus	359 (185%)	-8 (-1%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	56 (NA)	0 (0%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Positive values indicate a higher value in H3 than in EXISTING CONDITIONS or NAA.

<sup>b</sup> Based on daily data; all other locations use monthly data; 1922–2003.

10

11 **H1/LOS**

12 There would be generally no differences in mean flows year-round between H1 and H3 in the  
13 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
14 conducted only for the Feather River.

15 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
16 ammocoete cohort exposure between NAA and H1 at the 50% through 80% flow reductions (Table  
17 11-4-126). For the 85% and 90% flow reductions, ammocoete exposure under H1 would be 6% and  
18 5% lower, respectively, than that under NAA. These results indicate that there will be very small  
19 beneficial effects of H1 on Pacific lamprey ammocoete rearing in the Feather River.

1 **Table 11-4-126. Percent Difference between Baselines and H1 and H4 Model Scenarios in the**  
 2 **Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions,**  
 3 **Feather River at Thermalito Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>			
	EXISTING CONDITIONS vs. H1	NAA vs. H1	EXISTING CONDITIONS vs. H4	NAA vs. H4
-50%	0	0	0	0
-55%	0	0	0	0
-60%	0	0	0	0
-65%	0	0	0	0
-70%	0	0	0	0
-75%	0	0	0	0
-80%	0	2	-2	0.2
-85%	23	-6	14	-13
-90%	-53	-5	7	114

<sup>a</sup> Negative values indicate reduced cohort exposure under H1 or H4.

4  
 5 There would generally be no differences in mean water temperatures year-round between H1 and  
 6 H3 in any river examined. As a result, no additional ammocoete temperature cohort exposure  
 7 analyses were conducted for H1. Results of these analyses for H1 would be the same as those for H3.

8 Overall, these results indicate that results for H1 would generally be similar to those under H3.

9 **H4/HOS**

10 There would be generally no differences in mean flows year-round between H4 and H3 in the  
 11 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
 12 conducted only for the Feather River.

13 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
 14 ammocoete cohort exposure between NAA and H4 at the 50% through 80% flow reductions (Table  
 15 11-4-126). For the 85% and 90% flow reductions, ammocoete exposure under H4 would be 13%  
 16 lower and 114% higher, respectively.

17 There would generally be no differences in mean water temperatures year-round between H4 and  
 18 H3 in any river examined. As a result, no additional ammocoete cohort exposure analyses were  
 19 conducted for H4. Results of these analyses for H4 would be the same as those for H3.

20 Overall, these results indicate that results for H4 would generally be similar to those under H3  
 21 except for an increase in ammocoete stranding risk exposure in the Feather River at 90% flow  
 22 reduction under H4 if water operations were to move to this end of the operational range.

23 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
 24 substantially reduce rearing habitat or substantially reduce the number of fish as a result of  
 25 ammocoete mortality. There would generally be negligible effects or beneficial effects of H3 on  
 26 Pacific lamprey ammocoete stranding risk in all rivers evaluated. Stranding risk under both H1 and  
 27 H4 in the Feather River at Thermalito Afterbay would be higher than those under H3, such that  
 28 benefits to stranding risk predicted for H3 would not be as large under these limits of the

1 operational range. There would be increase and decreases in exposure risk of ammocoetes to  
2 elevated temperatures within each river evaluated that would balance out such that there would be  
3 no net effect on Pacific lamprey ammocoetes.

4 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
5 and quality of rearing habitat for Pacific lamprey would not be affected relative to the CEQA  
6 baseline.

### 7 **H3/ESO**

8 Comparisons of H3 to Existing Conditions for the Sacramento River at Keswick indicate negligible  
9 changes (<5%) in occurrence of flow reductions for all flow reduction categories, with the exception  
10 of a small increase (7%) in occurrence of month-over-month flow reductions of 80% and a more  
11 substantial increase (161 to 236 cohorts or 47%) for 85% flow reductions (Table 11-4-119).  
12 Comparisons for the Sacramento River at Red Bluff indicate no effect (0%) or negligible effects  
13 (<5%) for all flow reduction categories with the exception of a small increase in exposure (6%) for  
14 80% flow reduction events and a more substantial increase in exposure (56 to 112 cohorts or a  
15 100% increase for 85% flow reduction events) (Table 11-4-120). Based on the fact that increases in  
16 exposure would only be substantial for a single flow reduction category, H3 would not be expected  
17 to have biologically meaningful negative effects on spawning success in the Sacramento River but  
18 would contribute incrementally to regional effects.

19 Increases of 18–41% are predicted for flow reductions from 75% to 90% for the Trinity River (Table  
20 11-4-121); the percentages correspond generally to increased occurrences from approximately 400  
21 events for Existing Conditions to approximately 500 events for H3. Despite the prevalence of  
22 increased exposure risk to the higher flow reduction events, the percentage of cohorts exposed to  
23 stranding risk is relatively small compared to the total number of cohorts and therefore effects on  
24 spawning success in the Trinity River would not be biologically meaningful but would contribute  
25 incrementally to regional effects.

26 Comparisons for the American River at Nimbus Dam (Table 11-4-123) and at the confluence with  
27 the Sacramento River (Table 11-4-124) indicate increased chance of occurrence of flow reductions  
28 between 65% or 70% and 90% for H3 compared to Existing Conditions; predicted increases ranged  
29 from 39 to 352% for Nimbus Dam and from 7 to 268% for the confluence. These persistent and  
30 substantial increases in exposures to larger flow reduction events would have biologically  
31 meaningful effects on Pacific lamprey ammocoete cohort stranding and therefore spawning success  
32 in the American River.

33 The number of ammocoete cohorts exposed to 71.6°F under H3 would be higher than those under  
34 Existing Conditions in most locations examined, except in the Sacramento River at Keswick and in  
35 the Feather River at the Fish Barrier Dam (Table 11-4-125).

### 36 **H1/LOS**

37 There would be generally no differences in mean flows year-round between H1 and H3 in the  
38 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
39 conducted only for the Feather River.

40 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
41 ammocoete cohort exposure between Existing Conditions and H1 at the 50% through 80% flow

1 reductions (Table 11-4-126). For the 85% and 90% flow reductions, ammocoete exposure under H1  
2 would be 23% higher and 53% lower, respectively.

3 There would generally be no differences in mean water temperatures year-round between H1 and  
4 H3 in any river examined. As a result, no additional ammocoete cohort exposure analyses were  
5 conducted for H1. Results of these analyses for H1 would be the same as those for H3.

6 Overall, these results indicate that results for H1 would generally be similar to those under H3  
7 except for an increase in ammocoete stranding risk exposure in the Feather River at Thermalito  
8 Afterbay for the 80% flow reduction under H1 if water operations were to move to this end of the  
9 operational range.

#### 10 **H4/HOS**

11 There would be generally no differences in mean flows year-round between H4 and H3 in the  
12 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
13 conducted only for the Feather River.

14 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
15 ammocoete cohort exposure between Existing Conditions and H4 at the 50% through 80% flow  
16 reductions (Table 11-4-126). For the 85% and 90% flow reductions, ammocoete exposure under H4  
17 would be 14% and 7% higher, respectively.

18 There would generally be no differences in mean water temperatures year-round between H4 and  
19 H3 in any river examined. As a result, no additional ammocoete cohort exposure analyses were  
20 conducted for H4. Results of these analyses for H4 would be the same as those for H3.

21 Overall, these results indicate that results for H4 would generally be similar to those under H3.

#### 22 **Summary of CEQA Conclusion**

23 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between  
24 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
25 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
26 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Risk of redd  
27 dewatering would increase to some degree under higher flow reductions in the Sacramento River at  
28 Red Bluff (56 to 112 cohorts or a 100% increase for 85% flow reduction events) and the Trinity  
29 River (increases of 18–41% for flow reductions from 75% to 90%), and substantially in the  
30 American River at Nimbus Dam (increases from 39% to 352%) and at the confluence with the  
31 Sacramento (39% to 356%). Flow reductions would increase the risk of ammocoete stranding and  
32 desiccation in these rivers. There would be a beneficial effect from decreased occurrence of flow  
33 reduction events (=reduced ammocoete stranding risk) in the Feather River (-12% to -53% for the  
34 three largest flow reduction categories) but this effect would not offset the more substantial  
35 reductions in the other locations. Stranding risk under both H1 and H4 in the Feather River would  
36 be higher than those under H3, such that benefits under H3 would not occur under these limits of  
37 the operational range. There would be an increase in exposure to critical water temperatures in all  
38 locations examined except the Sacramento River at Keswick, and the Feather River at the Fish  
39 Barrier Dam. Increased exposure to higher water temperatures would increase stress and mortality  
40 of ammocoetes.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
2 change, future water demands, and implementation of the alternative. The analysis described above  
3 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
4 alternative from those of sea level rise, climate change and future water demands using the model  
5 simulation results presented in this chapter. However, the increment of change attributable to the  
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
8 implementation period, which does include future sea level rise, climate change, and water  
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
13 term implementation period and H3 indicates that flows in the locations and during the months  
14 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
15 indicates that the differences between Existing Conditions and Alternative 4 found above would  
16 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
17 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
18 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
19 impact on rearing habitat for Pacific lamprey. This impact is found to be less than significant and no  
20 mitigation is required.

### 21 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

22 In general, the effect of Alternative 4 on Pacific lamprey migration conditions would be negligible  
23 relative to the NAA.

### 24 **H3/ESO**

25 After 5 to 7 years, Pacific lamprey ammocoetes migrate downstream and become macrophthalmia  
26 (juveniles) once they reach the Delta. Migration generally is associated with large flow pulses in  
27 winter months (December through March) (USFWS unpublished data) meaning alterations in flow  
28 have the potential to affect downstream migration conditions. The effects of H3 water operations on  
29 seasonal migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow  
30 output. Flow rates along the likely migration pathways of Pacific lamprey during the likely  
31 macrophthalmia migration period (December through May) were examined for the Sacramento River  
32 at Rio Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, and the  
33 American River at the confluence with the Sacramento River.

34 The adult Pacific lamprey upstream migration period occurs between January and June. CALSIM II  
35 flow outputs were examined during these periods for each model scenario.

### 36 ***Sacramento River***

#### 37 ***Macrophthalmia***

38 Flows the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
39 *Analysis*) were examined during the December to May macrophthalmia migration period. Flows  
40 under H3 would generally be lower by up to 25% under H3 relative to NAA. Based on the prevalence  
41 of moderate decreases in flow in drier water years for much of migration period, H3 would affect

1 Pacific lamprey macrophthalmia migration conditions at this location. In the Sacramento River  
2 upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), flows  
3 under H3 during December through May would be similar to or greater than flows under NAA.

#### 4 *Adults*

5 Flows in the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the*  
6 *Fish Analysis*) were examined during the January to June adult migration period. Flows under H3  
7 would be similar to flows under NAA during January through April and slightly greater (by up to  
8 12%) during May and June. These results indicate that H3 would generally not affect adult migration  
9 conditions in the Sacramento River.

#### 10 **Feather River**

##### 11 *Juveniles*

12 Flows in the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
13 *Model Results utilized in the Fish Analysis*) were examined during the December to May  
14 macrophthalmia migration period. Flows under H3 during would generally be similar to or greater  
15 (up to 23% greater) than flows under NAA. These results indicate that effects of H3 on  
16 macrophthalmia migration flows in the Feather River would generally be negligible.

##### 17 *Adults*

18 Flows in the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
19 *Model Results utilized in the Fish Analysis*) were examined during the January through June adult  
20 migration period. Flows under H3 would generally be similar to flows under NAA during January  
21 through April and greater by up to 65% during May and June. Increases in flow would have a  
22 beneficial effect on migration conditions. These results indicate that H3 would not have negative  
23 effects on adult migration conditions in the Feather River.

#### 24 **American River**

##### 25 *Juveniles*

26 Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*) were examined during the December through March  
28 macrophthalmia migration period. Flows under H3 would generally be similar to flows under NAA  
29 with few small exceptions. These results indicate that H3 would not have negative effects on  
30 macrophthalmia migration conditions in the American River.

##### 31 *Adults*

32 Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*) were examined during the January to June adult migration  
34 period. Flows under H3 during January through April would generally be similar to flows under NAA  
35 with few small exceptions. Flows under H3 during May and June would generally be greater by up to  
36 25% than flows under NAA. Increases in flow would have a beneficial effect on migration conditions.  
37 These results indicate that H3 would not have negative effects on adult migration conditions in the  
38 American River.

1       **H1/LOS**

2       Flows in the Sacramento River at Rio Vista and upstream of Red Bluff under H1 during the  
3       December through May macrophthalmia migration period would generally be similar to or greater  
4       than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in  
5       the Sacramento River at Red Bluff under H1 during the January through June migration period  
6       would generally be similar to or greater than flows under H3.

7       Flows in the Feather River at the confluence with the Sacramento River under H1 during the  
8       December through May macrophthalmia migration period and the January through June adult  
9       migration period would generally be similar to or greater than flows under H3 (Appendix 11C,  
10       *CALSIM II Model Results utilized in the Fish Analysis*).

11       Flows in the American River at the confluence with the Sacramento River under H1 during the  
12       December through May macrophthalmia migration period and the January through June adult  
13       migration period would generally be similar to or greater than flows under H3 (Appendix 11C,  
14       *CALSIM II Model Results utilized in the Fish Analysis*).

15       These results indicate that the effects of H1 on Pacific lamprey migration conditions would generally  
16       be the same as those under H3.

17       **H4/HOS**

18       Flows in the Sacramento River at Rio Vista and upstream of Red Bluff under H4 during the  
19       December through May macrophthalmia migration period would generally be similar to or greater  
20       than (up to 35% greater) flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
21       *Analysis*), indicating that migration conditions for macrophthalmia would be improved under H4  
22       relative to H3. Flows in the Sacramento River at Red Bluff under H4 during the January through June  
23       migration period would generally be similar to or greater than (up to 35% greater) flows under H3,  
24       except during June in which flows under H4 would be up to 21% lower. Overall, due to infrequent  
25       differences, flows would not be different under H4 than those under H3.

26       Flows in the Feather River at the confluence with the Sacramento River under H4 during the  
27       December through May macrophthalmia migration period would generally be similar to or greater  
28       than (up to 100% greater) flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
29       *Fish Analysis*), indicating that migration conditions for macrophthalmia would be improved under H4  
30       relative to H3. Flows in the Feather River at the confluence with the Sacramento River under H4  
31       during the January through June migration period would generally be similar to or greater than (up  
32       to 100% greater) flows under H3, except during June in which flows under H4 would be up to 29%  
33       lower. Overall, due to infrequent differences, flows would not be different under H4 than those  
34       under H3.

35       Flows in the American River at the confluence with the Sacramento River under H4 during the  
36       December through May macrophthalmia migration period and the January through June adult  
37       migration period would generally be similar to or greater than flows under H3 (Appendix 11C,  
38       *CALSIM II Model Results utilized in the Fish Analysis*).

39       These results indicate that the effects of H4 on Pacific lamprey migration conditions would generally  
40       be the same as those under H3.

1 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
2 substantially reduce or degrade migration habitat or substantially reduce the number of fish as a  
3 result of mortality. Effects of Alternative 4 on mean monthly flow for the macrophthalmia and adult  
4 migration periods consist primarily of negligible effects (<5%) in all locations analyzed, with  
5 infrequent and small decreases in flow for some months/water years that would not have  
6 biologically meaningful effects on migration conditions, with the exception of small to moderate  
7 flow reductions (to -29%) for some months and water year types during the migration periods in  
8 the Sacramento River at Rio Vista. The degree to which this reduction would affect lamprey is  
9 unknown, but given the predominance of negligible effects in other locations, it is not likely that  
10 reduced flows at this location would affect the Pacific lamprey population.

11 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
12 and quality of migration habitat for Pacific lamprey would not be reduced relative to the CEQA  
13 baseline.

### 14 H3/ESO

#### 15 Sacramento River

##### 16 Macrophthalmia

17 Comparisons of mean monthly flow rates for H3 to Existing Conditions in the Sacramento River at  
18 Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May  
19 indicate negligible effects (<5% difference) from H3 or reductions in flow ranging from -5% to -47%  
20 in most water years for each of these months, with only a single occurrence of a small increase in  
21 flow during May in dry years (11%). There would be negligible effects or small (to approximately -  
22 11%) to moderate (to -26%) reductions in flow during drier water years under H3, when flow  
23 reductions would be more critical for migration conditions.

24 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*  
25 *in the Fish Analysis*) for December to May indicate negligible effects (<5%) or small increases or  
26 decreases in flow (to 12%) under H3 that would not have biologically meaningful effects on  
27 migration conditions. Exceptions include a decrease in flow of -17% during May in wet years under  
28 H3 when flow reductions would not be as critical for migration conditions. Overall, the effects of H3  
29 would primarily consist of negligible effects (<5%), and small increases or decreases that would not  
30 have biologically meaningful effects on macrophthalmia migration conditions.

##### 31 Adults

32 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*) for January through June for H3 relative to Existing  
34 Conditions indicate that for most months and water year types, flows under H3 would be similar to  
35 (<5% difference) or greater than flows under Existing Conditions, with increases in mean monthly  
36 flow to 20% that would have a beneficial effect on migration conditions, and a small decrease in flow  
37 during March in below normal years (-10%) and a moderate decrease (-17%) during May in wet  
38 years when flow reductions would be less critical for migration conditions. Increases in mean  
39 monthly flow, particularly those that would occur in drier water years during January, March, May  
40 and June, would have beneficial effects on migration conditions. These results indicate that the  
41 effects of H3 on flow consist predominantly of negligible effects (<5%) or increases in flow (to 20%)

1 that would be beneficial for migration, and infrequent and small reductions in flow that would not  
2 have biologically meaningful negative effects on migration conditions.

### 3 **Feather River**

#### 4 *Juveniles*

5 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,  
6 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable effects of  
7 H3 relative to Existing Conditions by month and water year type, with negligible effects (<5%),  
8 moderate increases in flow (to 20%) that would be beneficial for migration conditions, with  
9 occasional occurrences of moderate decreases in flow to -26%. Decreases in flow would occur in  
10 below normal years during January (-15%), February (-11%) and March (-20%), but otherwise  
11 effects of H3 in drier water years consist of negligible effects or increases in flow that would have  
12 beneficial effects. These results indicate that the effects of H3 on flows would not have negative  
13 effects on macrophthalmia migration in the Feather River.

#### 14 *Adults*

15 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento  
16 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
17 indicate variable effects of H3 relative to Existing Conditions depending on the month and water  
18 year type, with primarily negligible effects (<5%), small to substantial increases in flow (to 59%)  
19 that would have a beneficial effect on migration conditions, and occasional small to moderate  
20 decreases in flow, including during January through March in below normal years (to -20%), during  
21 May in wet years (-26%) when effects on migration conditions would be less critical, and during  
22 June in wet (-8%) and critical (-10%) years. Based on the prevalence of negligible effects and  
23 increases in flow which would have a beneficial effect on migration conditions, and only occasional  
24 reductions in flow of small to moderate magnitude, these results indicate that effects of H3 on flow  
25 would not have biologically meaningful negative effects on adult migration conditions in the Feather  
26 River.

### 27 **American River**

#### 28 *Juveniles*

29 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,  
30 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable effects of  
31 H3 relative to Existing Conditions, with negligible effects (<5%) or decreases in flow during  
32 December, increases in flow during January through March for some wetter water year types (to  
33 27%) and decreases for some drier water year types (to -19%), negligible effects or small increases  
34 or decreases (to 9%) during April, and decreases to -31% during May in all water year types except  
35 dry (increase of 12%). Decreases in drier water years for December and January, and in critical  
36 years during February and March encompass much of the migration period and would affect  
37 macrophthalmia migration conditions for that time-frame, particularly in critical years. These results  
38 indicate that there would be moderate to substantial decreases in mean monthly flow for much of  
39 the migration period (to -31%), including in drier water years, that would affect Pacific lamprey  
40 migration conditions.

1 **Adults**

2 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento  
3 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June  
4 indicate variable effects of H3 relative to Existing Conditions depending on the month and water  
5 year type, with primarily increases in mean monthly flow (to 27%) during January through March in  
6 wetter years, and decreases (to -19%) in drier years. There would be primarily negligible effects  
7 (<5%) or small increases or decreases (to 9%) during April. There would be decreases (to -31%) in  
8 all but critical years (increase of 12%) during May, and decreases during June in wet (-29%) and  
9 critical (-39%) years with increases (to 23%) in the remaining water years. Effects during dry and  
10 critical years when changes in flow would be more important for migration include negligible effects  
11 and increases and decreases in mean monthly flows throughout the migration period. The largest  
12 flow reductions in drier water years would not occur until late in the migration period (May and  
13 June). These results indicate that effects of H3 consist of variable effects on flow and flow reductions  
14 in some months would be offset by increases in other months and would not have biologically  
15 meaningful effects on adult migration conditions.

16 **H1/LOS**

17 Flows in the Sacramento River at Rio Vista and upstream of Red Bluff under H1 during the  
18 December through May macrophthalmia migration period would generally be similar to or greater  
19 than flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in  
20 the Sacramento River at Red Bluff under H1 during the January through June migration period  
21 would generally be similar to or greater than flows under H3.

22 Flows in the Feather River at the confluence with the Sacramento River under H1 during the  
23 December through May macrophthalmia migration period and the January through June adult  
24 migration period would generally be similar to or greater than flows under H3 (Appendix 11C,  
25 *CALSIM II Model Results utilized in the Fish Analysis*).

26 Flows in the American River at the confluence with the Sacramento River under H1 during the  
27 December through May macrophthalmia migration period and the January through June adult  
28 migration period would generally be similar to or greater than flows under H3 (Appendix 11C,  
29 *CALSIM II Model Results utilized in the Fish Analysis*).

30 These results indicate that the effects of H1 on Pacific lamprey migration conditions would generally  
31 be the same as those under H3.

32 **H4/HOS**

33 Flows in the Sacramento River at Rio Vista and upstream of Red Bluff under H4 during the  
34 December through May macrophthalmia migration period would generally be similar to or greater  
35 than (up to 35% greater) flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish  
36 Analysis*), indicating that migration conditions for macrophthalmia would be improved under H4  
37 relative to H3. Flows in the Sacramento River at Red Bluff under H4 during the January through June  
38 migration period would generally be similar to or greater than (up to 35% greater) flows under H3,  
39 except during June in which flows under H4 would be up to 21% lower. Overall, due to infrequent  
40 differences, flows would not be different under H4 than those under H3.

41 Flows in the Feather River at the confluence with the Sacramento River under H4 during the  
42 December through May macrophthalmia migration period would generally be similar to or greater

1 than (up to 100% greater) flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
2 *Fish Analysis*), indicating that migration conditions for macrophthalmia would be improved under H4  
3 relative to H3. Flows in the Feather River at the confluence with the Sacramento River under H4  
4 during the January through June migration period would generally be similar to or greater than (up  
5 to 100% greater) flows under H3, except during June in which flows under H4 would be up to 29%  
6 lower. Overall, due to infrequent differences, flows would not be different under H4 than those  
7 under H3.

8 Flows in the American River at the confluence with the Sacramento River under H4 during the  
9 December through May macrophthalmia migration period and the January through June adult  
10 migration period would generally be similar to or greater than flows under H3 (Appendix 11C,  
11 *CALSIM II Model Results utilized in the Fish Analysis*).

12 These results indicate that the effects of H4 on Pacific lamprey migration conditions would generally  
13 be the same as those under H3.

#### 14 **Summary of CEQA Conclusion**

15 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between  
16 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
17 alternative could substantially reduce the amount of suitable habitat and substantially interfere with  
18 the movement of fish. Alternative 4 would cause decreases in mean monthly flow to -31% in the  
19 American River during a substantial portion of the macrophthalmia migration period, including in  
20 drier water year types. A prevalence of flow reductions in the Sacramento River at Rio Vista (to -  
21 47%, including moderate reductions, to -26%, in drier water year types) would contribute  
22 incrementally to negative effects. Flow reductions during the macrophthalmia life stage would  
23 increase migration delays to the ocean life stage and straying and increase the risk of mortality.  
24 Effects of Alternative 4 in the other locations analyzed would consist of negligible effects and/or  
25 increases or decreases in mean monthly flow that would generally balance out throughout the  
26 macrophthalmia and adult migration periods, with the exception of greater magnitude and  
27 occurrence of beneficial increases in flow in the Feather River that would enhance migration  
28 conditions at that location. These results are consistent among scenarios.

29 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
30 change, future water demands, and implementation of the alternative. The analysis described above  
31 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
32 alternative from those of sea level rise, climate change and future water demands using the model  
33 simulation results presented in this chapter. However, the increment of change attributable to the  
34 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
35 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
36 implementation period, which does include future sea level rise, climate change, and water  
37 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
38 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
39 effect of the alternative from those of sea level rise, climate change, and water demands.

40 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
41 term implementation period and H3 indicates that flows in the locations and during the months  
42 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
43 indicates that the differences between Existing Conditions and Alternative 4 found above would  
44 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a

1 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
2 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
3 impact on migration conditions for Pacific lamprey. This impact is found to be less than significant  
4 and no mitigation is required.

5 **Restoration Measures (CM2, CM4–CM7, and CM10)**

6 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
7 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
8 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
9 restoration measures described for Pacific lamprey under Alternative 1A (Impacts AQUA-169  
10 through AQUA-171) also appropriately characterize effects under Alternative 4.

11 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

12 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

13 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**  
14 **Lamprey**

15 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

16 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms  
17 on Pacific lamprey are the same for Alternative 4, as those described under Alternative 1A (Impacts  
18 AQUA 169-through AQUA-171). The effects would not be adverse, and would generally be beneficial.

19 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or  
20 less than significant, and no mitigation is required.

21 **Other Conservation Measures (CM12–CM19 and CM21)**

22 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
23 differences in other conservation-related fish effects are anticipated anywhere in the affected  
24 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
25 effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impacts  
26 AQUA-172 through AQUA-180) also appropriately characterize effects under Alternative 4.

27 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

28 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

29 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**  
30 **(CM13)**

31 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

32 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**  
33 **(CM15)**

34 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

1 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

2 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

3 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

4 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**  
5 **Lamprey (CM21)**

6 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms  
7 on Pacific lamprey are the same as those described under Alternative 1A (Impacts AQUA-172  
8 through AQUA-180). The effects range from no effect, to not adverse, to beneficial.

9 **CEQA Conclusion:** The effects of the nine impact mechanisms listed above range from no impact, to  
10 less than significant, to beneficial, and no mitigation is required.

11 **River Lamprey**

12 **Construction and Maintenance of CM1**

13 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

14 The potential effects of construction of water conveyance facilities on river lamprey would be  
15 similar to those described for Alternative 1A, Impact AQUA-181, except that Alternative 4 would  
16 include three intakes compared to five intakes under Alternative 1A, so the effects would be  
17 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing  
18 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and  
19 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
20 would require 27.3 acres of dredging. Alternative 4 would use five barge locations rather than six as  
21 under Alternative 1A so those effects would also be proportionally less. Additionally, construction  
22 and excavation at Clifton Court Forebay would be done in the dry via installation of cofferdams for  
23 isolation and dewatering of work areas. Implementation of Appendix 3B, *Environmental*  
24 *Commitments*, including construction BMPs and 3B.8–*Fish Rescue and Salvage Plan*, would minimize  
25 adverse effects as described for Alternative 1A. Mitigation measures would also be available to avoid  
26 and minimize potential effects.

27 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181, the effect would not be adverse  
28 for river lamprey.

29 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-181, the impact of the construction  
30 of water conveyance facilities on river lamprey would not be significant except for construction  
31 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A  
32 because only three intakes would be constructed rather than five. Implementation of Mitigation  
33 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than  
34 significant.

35 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
36 **of Pile Driving and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
38 Alternative 1A.

1           **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
2           **and Other Construction-Related Underwater Noise**

3           Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
4           Alternative 1A.

5           **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

6           The potential effects of the maintenance of water conveyance facilities under Alternative 4 would be  
7           the same as those described for Alternative 1A (see Impact AQUA-182) except that only three  
8           intakes would need to be maintained under Alternative 4 rather than five under Alternative 1A. As  
9           concluded in Alternative 1A, Impact AQUA-182, the impact would not be adverse for river lamprey.

10          **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance  
11          of water conveyance facilities on river lamprey would be less than significant and no mitigation is  
12          required.

13          **Water Operations of CM1**

14          **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

15          **Water Exports**

16          The impact on entrainment of river lamprey at water operations facilities in the south and north  
17          Delta is expected to be the same as described for Pacific lamprey (see Impact AQUA-165).  
18          Entrainment losses at the south Delta facilities would be reduced for all flow scenarios under  
19          Alternative 4 compared to NAA. The potential impacts at the proposed new north Delta intakes are  
20          unknown since little is known about the river lamprey life history in the Delta.

21          **Predation Associated with Entrainment**

22          Entrainment-related predation loss of lamprey at the south Delta facilities would not be greater  
23          under this Alternative and may be lower due to a reduction in entrainment loss. Conditions under  
24          Scenario H4 would decrease predation loss relative to NAA and Scenario H3, while conditions would  
25          be similar between Scenario H1 and Scenario H3. Predation at the north Delta would be increased  
26          due to the installation of the proposed water export facilities on the Sacramento River. The effect on  
27          lamprey from predation loss at the north Delta facilities is unknown because of the lack of  
28          knowledge about their distribution and population abundances in the Delta.

29          **NEPA Effects:** Overall, it is expected that the effect of predation loss on lamprey under Alternative 4  
30          may be moderate, but would not be adverse.

31          **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be substantially  
32          reduced under all flow scenarios for Alternative 4 relative to existing biological conditions. The  
33          impact of predation loss at the north Delta is unknown, since there is little available knowledge on  
34          the distribution and abundance in the Delta, especially in the vicinity of the proposed new north  
35          Delta intakes. Overall the impact on River lamprey from water operations is expected to be less than  
36          significant. No mitigation would be required.

**Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey**

In general, the effect of Alternative 4 would be negligible relative to the NAA.

**H3/ESO**

Flow-related impacts to river lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames for river lamprey incorporated into the analysis. The same locations were analyzed as for Pacific lamprey: the Sacramento River at Keswick and Red Bluff, Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, and the American River at Nimbus Dam and at the confluence with the Sacramento River. River lamprey spawn in these rivers between February and June so flow reductions during those months have the potential to dewater redds, which could result in incomplete development of the eggs to ammocoetes (the larval stage).

Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning location suitability characteristics (e.g., depth, velocity, and substrate) of river lamprey are not adequately described to employ a more formal analysis such as a weighted usable area analysis. Therefore, as described for Pacific lamprey, there is uncertainty that these values represent actual redd dewatering events, and results should be treated as rough estimates of flow fluctuations under each model scenario. Results were expressed as the number of cohorts exposed to dewatering risk and as a percentage of the total number of cohorts anticipated in the river based on the applicable time-frame, February to June.

There would be negligible differences between H3 and NAA in exposure to flow reductions in all rivers except for a small decrease (8% lower) in the Trinity River at Lewiston Dam and a small (6% greater) increase in the American River at Nimbus Dam (Table 11-4-127). These results indicate that H3 would not have biologically meaningful effects on river lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than 50% in all locations analyzed.

**Table 11-4-127. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts<sup>a</sup>**

Location	EXISTING CONDITIONS vs. H3	NAA vs. H3
Sacramento River at Keswick	3 (9%)	0 (0%)
Sacramento River at Red Bluff	-1 (-3%)	-3 (-8%)
Trinity River downstream of Lewiston	-4 (-6%)	-2 (-3%)
Feather River below Thermalito Afterbay	-8 (-12%)	2 (3%)
American River at Nimbus	13 (24%)	4 (6%)
American River at Sacramento River confluence	19 (32%)	2 (3%)

<sup>a</sup> Difference and percent difference between model scenarios in the number of river lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%. Positive values indicate a higher value in H3 than in Existing Conditions or NAA.

River lamprey generally spawn between February and June (Beamish 1980; Moyle 2002). Using Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same

1 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...  
2 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for  
3 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,  
4 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both  
5 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.  
6 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM  
7 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from  
8 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods  
9 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data  
10 from the Bureau’s temperature model. Each individual day or month starts a new “egg cohort” such  
11 that there are 12.320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid  
12 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using  
13 monthly data over the same period. The incubation periods used in this analysis are conservative  
14 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of  
15 the monthly average time step is limited because the extreme temperatures are masked; however,  
16 no better analytical tools are currently available for this analysis. Spawning locations of river  
17 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is  
18 thought to spawn in each river.

19 For both thresholds, there would be few differences in egg cohort exposure between NAA and H3  
20 among all sites (Table 11-4-128). In all cases, absolute differences account for <5% of the total  
21 number of cohorts; thus, none of these differences would have biologically meaningful effects.

1 **Table 11-4-128. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg**  
2 **Cohort Temperature Exposure<sup>a</sup>**

Location	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>Temperatures above 71.6°F</b>		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	291 (NA)	-32 (-10%)
Trinity River at Lewiston	0 (NA)	-1 (-100%)
Trinity River at North Fork	4 (NA)	-1 (-20%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	39 (433%)	10 (26%)
American River at Nimbus	23 (460%)	-2 (-7%)
American River at Sacramento River Confluence	43 (154%)	-11 (-13%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	34 (3,400%)	0 (0%)
<b>Temperatures above 77°F</b>		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	39 (NA)	3 (8%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	3 (NA)	1 (50%)
American River at Nimbus	4 (NA)	0 (0%)
American River at Sacramento River Confluence	8 (NA)	2 (33%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Difference and percent difference between model scenarios in the number of river lamprey egg cohorts experiencing water temperatures above 71.6°F and 77°F during February through June on at least one day during a 49-day incubation period in the Sacramento River or for at least one month during a 2-month incubation period in other rivers for each model scenario. Positive values indicate a higher value in H3 than in EXISTING CONDITIONS or NAA.

3

4 **H1/LOS**

5 Flows during February through June under H1 would generally be similar to or greater than flows  
6 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
7 not conducted for H1 in these rivers and results for H1 would be the same as those for H3.

8 In the Feather River at Thermalito Afterbay, there would be 5 more cohorts (9%) exposed to a 50%  
9 month over month drop in flow rate under H1 relative to NAA (Table 11-4-129). This change of 5  
10 cohorts out of 410 cohorts would be negligible to the population.

1 **Table 11-4-129. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**  
2 **Cohorts<sup>a</sup>**

Location	EXISTING		EXISTING	
	CONDITIONS vs. H1	NAA vs. H1	CONDITIONS vs. H4	NAA vs. H4
Feather River at Thermalito Afterbay	-5 (-7%)	5 (9%)	4 (6%)	14 (24%)

<sup>a</sup> Difference and percent difference between model scenarios in the number of river lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%. Positive values indicate a higher value in H1 or H4 than in Existing Conditions or NAA.

3  
4 Water temperatures would not differ between H1 and H3 and, therefore, no egg cohort temperature  
5 analyses were conducted. Overall, results for H1 would be similar to those for H3.

6 **H4/HOS**

7 Flows during January through August under H4 would generally be similar to or greater than flows  
8 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
9 not conducted for H4 in these rivers and results for H4 would be the same as those for H3.

10 In the Feather River at Thermalito Afterbay, there would be 14 more cohorts (24%) exposed to a  
11 50% month over month drop in flow rate under H4 relative to NAA (Table 11-4-129). This change of  
12 14 cohorts out of 410 cohorts would be negligible to the population.

13 Water temperatures would not differ between H4 and H3 and, therefore, no egg cohort temperature  
14 analyses were conducted. Overall, results for H4 would be similar to those for H3.

15 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
16 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result  
17 of egg mortality. Effects of Alternative 4 on river lamprey redd dewatering risk would be negligible  
18 for all locations analyzed. Exposure risk of eggs to elevated water temperatures under Alternative 4  
19 would be similar to or lower than that of NAA at all locations. These results are consistent among  
20 scenarios.

21 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
22 and quality of spawning and egg incubation habitat for river lamprey would not be affected relative  
23 to the CEQA baseline.

24 **H3/ESO**

25 Effects of H3 relative to Existing Conditions on flow reductions during the river lamprey spawning  
26 period from February to June in the Sacramento River and American River consist of small to  
27 substantial increases in dewatering risk in the Sacramento River at Keswick (9%) and the American  
28 River (to 32%), and negligible effects (<5%) or small decreases in redd cohort dewatering risk in the  
29 Sacramento River at Red Bluff (<5%), the Trinity River (-6%) and the Feather River (-12%) (Table  
30 11-4-127). Effects of Alternative 4 on river lamprey redd dewatering in the American River consist  
31 of a substantial increase in risk that would affect river lamprey spawning success in that location  
32 (increases of 24% at Nimbus Dam and 32% at the confluence with the Sacramento River).

33 Egg cohort temperature exposure results are reported in Table 11-4-128. There would be increased  
34 exposure of egg cohorts (23 to 43 cohorts, or 154% to 3,400%) under H3 relative to Existing

1 Conditions to temperatures above 71.6°F in the Feather River, American River, and Stanislaus River.  
2 There would be 39 more cohorts exposed to temperatures above 77°F under H3 relative to Existing  
3 Conditions, although this absolute value, would not be biologically meaningful because it is a small  
4 proportion of the 12,320 total cohorts, There would be no differences in the number of cohorts  
5 exposed to the 77°F threshold.

#### 6 **H1/LOS**

7 Flows during February through June under H1 would generally be similar to or greater than flows  
8 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
9 not conducted for H1 in these rivers and results for H1 would be the same as those for H3.

10 In the Feather River at Thermalito Afterbay, there would be 5 fewer cohorts (7%) under H1 that  
11 would be exposed to a 50% flow reduction than under Existing Conditions (Table 11-4-129). This  
12 increase would be too small to have a biologically meaningful effect on river lamprey.

13 Water temperatures under H1 would be similar to those under H3 for all rivers examined.  
14 Therefore, no additional cohort temperature exposure analyses were conducted for H1.

15 Overall, results for H1 would be similar to those for H3.

#### 16 **H4/HOS**

17 Flows during February through June under H4 would generally be similar to or greater than flows  
18 under H3 in all rivers except the Feather River. As a result, the redd dewatering risk analysis was  
19 not conducted for H4 in these rivers and results for H4 would be the same as those for H3.

20 In the Feather River at Thermalito Afterbay, there would be 4 more cohorts (236 under H4 that  
21 would be exposed to a 50% flow reduction than under H3 (Table 11-4-129). This increase would be  
22 too small to have a biologically meaningful effect on river lamprey.

23 Water temperatures under H4 would be similar to those under H3 for all rivers examined.  
24 Therefore, no additional cohort temperature exposure analyses were conducted for H1.

25 Overall, results for H4 would be similar to those for H3.

#### 26 **Summary of CEQA Conclusion**

27 Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between  
28 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
29 alternative could substantially reduce suitable spawning habitat and substantially reduce the  
30 number of fish as a result of egg mortality. Increased risk of redd dewatering in the American River  
31 (to 32%) would increase the risk of desiccation and mortality of eggs, contrary to the NEPA  
32 conclusion set forth above. The increase in exposure of egg cohorts to critical water temperatures in  
33 the Feather River would increase stress and egg mortality. Flow reductions in the Sacramento,  
34 Feather, American, and Stanislaus Rivers would cause increased risk of redd dewatering for river  
35 lamprey under H4 if operations were changed to this limit.

36 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
37 change, future water demands, and implementation of the alternative. The analysis described above  
38 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
39 alternative from those of sea level rise, climate change and future water demands using the model

1 simulation results presented in this chapter. However, the increment of change attributable to the  
2 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
3 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT  
4 implementation period, which does include future sea level rise, climate change, and water  
5 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
6 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
7 effect of the alternative from those of sea level rise, climate change, and water demands.

8 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
9 term implementation period and H3 indicates that flows in the locations and during the months  
10 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
11 indicates that the differences between Existing Conditions and Alternative 4 found above would  
12 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
13 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
14 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
15 impact on spawning habitat for river lamprey. This impact is found to be less than significant and no  
16 mitigation is required.

### 17 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

18 In general, the effect of Alternative 4 would be negligible relative to the NAA.

#### 19 **H3/ESO**

20 Flow-related impacts to river lamprey rearing habitat were evaluated by estimating of the frequency  
21 of rapid flow reductions in ammocoete rearing areas. Rapid reductions in flow can strand  
22 ammocoetes, leading to mortality. Comparisons of effects were made for ammocoete cohorts, as  
23 described for Pacific lamprey, in the Sacramento River at Keswick and Red Bluff, the Trinity River,  
24 Feather River, and the American River at Nimbus Dam and at the confluence with the Sacramento  
25 River.

26 As for Pacific lamprey, the analysis of river lamprey ammocoete stranding was conducted by  
27 analyzing a range of month-over-month flow reductions from CALSIM II outputs, using the range of  
28 50%–90% in 5% increments. A cohort of ammocoetes was assumed to be born every month during  
29 their spawning period (February through June) and spend 5 years rearing upstream. Therefore, a  
30 cohort was considered stranded if at least one month-over-month flow reduction was greater than  
31 the flow reduction at any time during the period.

32 Comparisons of H3 to NAA for the Sacramento River at Keswick (Table 11-4-130) indicate that there  
33 would be no effect (0%) or negligible effects (<5%) attributable to H3 in all flow reduction  
34 categories.

1 **Table 11-4-130. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**  
 3 **Keswick**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	2	0
-60%	6	2
-65%	3	3
-70%	-2	-2
-75%	-6	0
-80%	11	0
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

4  
 5 Results of comparisons for the Sacramento River at Red Bluff indicates that H3 would have  
 6 negligible effects (<5%) or small to moderate decreases in cohort exposure (to -16%) that would  
 7 have a beneficial effect, attributable to the project for different flow reduction categories (Table 11-  
 8 4-131).

9 **Table 11-4-131. Percent Difference between Model Scenarios in the Number of River Lamprey**  
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**  
 11 **Bluff**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	6	3
-60%	12	5
-65%	-2	-3
-70%	10	1
-75%	10	-10
-80%	8	-16
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

12  
 13 Comparisons for the Trinity River indicate that there would be no or negligible differences in  
 14 ammocoete cohorts exposed flow reductions between H3 and NAA (Table 11-4-132).

1 **Table 11-4-132. Percent Difference between Model Scenarios in the Number of River Lamprey**  
2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	26	-5
-80%	39	0
-85%	31	0
-90%	59	4

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

3  
4 In the Feather River at Thermalito Afterbay, there would be no difference in ammocoete cohort  
5 exposure at the 50% through 75% flow reductions (Table 11-4-133). For the 80% through 90% flow  
6 reductions, ammocoete exposure would be 7% to 41% lower, which would have a beneficial effect  
7 on ammocoete rearing. These results indicate that there will be beneficial effects of H3 on river  
8 lamprey ammocoete rearing in the Feather River.

9 **Table 11-4-133. Percent Difference between Model Scenarios in the Number of River Lamprey**  
10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**  
11 **Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	-1	-1
-80%	-17	-11
-85%	-23	-41
-90%	-48	-7

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

12  
13 Comparisons for the American River at Nimbus Dam (Table 11-4-134) and at the confluence with  
14 the Sacramento River (Table 11-4-135) have similar results. There would be no or negligible  
15 differences in cohort exposure between NAA and H3 for the 50% to 70% flow reductions range,  
16 There would be higher cohort exposure under H3 relative to NAA at Nimbus Dam at the 75% flow  
17 reduction (9% higher) and at the confluence with the Sacramento River at the 75% (11% higher)  
18 and 80% (25% higher) flow reductions. There would be up to 24% lower cohort exposures under

1 H3 relative to NAA at the remaining flow reductions at both locations. These results indicate that  
2 there would generally be no effect of H3 on stranding risk in the American River with few small  
3 exceptions that would not be common enough to have biologically meaningful effects.

4 **Table 11-4-134. Percent Difference between Model Scenarios in the Number of River Lamprey**  
5 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**  
6 **Dam**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	4	0
-65%	5	-3
-70%	59	0
-75%	146	9
-80%	262	-24
-85%	416	-8
-90%	136	-21

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

7

8 **Table 11-4-135. Relative Difference between Model Scenarios in the Number of River Lamprey**  
9 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**  
10 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference <sup>a</sup>	
	EXISTING CONDITIONS vs. H3	NAA vs. H3
-50%	0	0
-55%	0	0
-60%	4	0
-65%	5	0
-70%	20	-3
-75%	71	11
-80%	323	25
-85%	240	-21
-90%	300	-14

<sup>a</sup> Negative values indicate reduced cohort exposure, a benefit of H3.

11

12 Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of  
13 Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et  
14 al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be  
15 conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day  
16 or month starts a new “cohort” such that there are 18,730 cohorts for the Sacramento River,  
17 corresponding to 82 years of ammocoetes being “born” every day each year from January 1 through  
18 August 31, and 380 cohorts for the other rivers using monthly data over the same period.

1 There would be differences in the number of ammocoete cohorts exposed to temperatures greater  
 2 than the thresholds in most of the rivers, particularly for the 77°F threshold (Table 11-4-136).  
 3 However, each river with an increase in exposure would also have a site with a decrease in exposure  
 4 of similar magnitude, except in the Feather River for the 77°F threshold. Overall, the increases and  
 5 decreases are expected to balance out within rivers such that there would be no overall effect on  
 6 river lamprey ammocoetes.

7 **Table 11-4-136. Differences (Percent Differences) between Model Scenarios in River Lamprey**  
 8 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F and 77°F**  
 9 **in at Least One Month**

Location	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>71.6°F Threshold</b>		
Sacramento River at Keswick <sup>b</sup>	0 (NA)	-1,218 (-100%)
Sacramento River at Hamilton City <sup>b</sup>	10,951 (NA)	1,456 (15%)
Trinity River at Lewiston	65 (NA)	15 (30%)
Trinity River at North Fork	135 (NA)	-25 (-16%)
Feather River at Fish Barrier Dam	0 (NA)	-25 (-100%)
Feather River below Thermalito Afterbay	180 (95%)	50 (16%)
American River at Nimbus	240 (267%)	-5 (-1%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	25 (NA)	0 (0%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
<b>77°F Threshold</b>		
Sacramento River at Keswick <sup>b</sup>	0 (NA)	0 (NA)
Sacramento River at Hamilton City <sup>b</sup>	0 (NA)	0 (NA)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	25 (NA)	25 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	65 (NA)	25 (63%)
American River at Nimbus	200 (NA)	-20 (-9%)
American River at Sacramento River Confluence	265 (530%)	35 (15%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> Positive values indicate a higher value in H3 than in EXISTING CONDITIONS or NAA.

<sup>b</sup> Based on daily data; all other locations use monthly data; 1922–2003.

10

11 **H1/LOS**

12 There would be generally no differences in mean flows year-round between H1 and H3 in the  
 13 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
 14 conducted only for the Feather River.

15 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
 16 ammocoete cohort exposure between NAA and H1 at the 50% through 75% flow reductions (Table

1 11-4-137). For the 85% flow reductions, ammocoete exposure under H1 would be 9% higher than  
 2 that under NAA, respectively. For the 90% and 95% flow reductions, ammocoete exposure under H1  
 3 would be 7% lower than that under NAA. Overall, these results indicate that there would generally  
 4 be no biologically meaningful effect of H1 on river lamprey ammocoete rearing in the Feather River.

5 **Table 11-4-137. Percent Difference between Baselines and H1 and H4 Model Scenarios in the**  
 6 **Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions,**  
 7 **Feather River at Thermalito Afterbay**

Percent Flow Reduction	Percent Difference <sup>a</sup>			
	EXISTING CONDITIONS vs. H1	NAA vs. H1	EXISTING CONDITIONS vs. H4	NAA vs. H4
-50%	0	0	0	0
-55%	0	0	0	0
-60%	0	0	0	0
-65%	0	0	0	0
-70%	0	0	0	0
-75%	0	0	0	0
-80%	2	9	-2	4
-85%	23	-7	17	-11
-90%	-48	-7	15	103

<sup>a</sup> Negative values indicate reduced cohort exposure under H1 or H4.

8  
 9 There would generally be no differences in mean water temperatures year-round between H1 and  
 10 H3 in any river examined. As a result, no additional ammocoete temperature cohort exposure  
 11 analyses were conducted for H1. Results of these analyses for H1 would be the same as those for H3.  
 12 Overall, these results indicate that results for H1 would generally be similar to those under H3.

13 **H4/HOS**

14 There would be generally no differences in mean flows year-round between H4 and H3 in the  
 15 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
 16 conducted only for the Feather River.

17 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
 18 ammocoete cohort exposure between NAA and H4 at the 50% through 80% flow reductions (Table  
 19 11-4-137). For the 85% and 90% flow reductions, ammocoete exposure under H4 would be 11%  
 20 lower and 103% higher, respectively.

21 There would generally be no differences in mean water temperatures year-round between H4 and  
 22 H3 in any river examined. As a result, no additional ammocoete cohort exposure analyses were  
 23 conducted for H4. Results of these analyses for H4 would be the same as those for H3.

24 Overall, these results indicate that results for H4 would generally be similar to those under H3  
 25 except for an increase in ammocoete stranding risk exposure in the Feather River at 90% flow  
 26 reduction under H4 if water operations were to move to this end of the operational range.

1 **NEPA Effects:** These results indicate the effect would not be adverse because it would not  
2 substantially reduce rearing habitat or substantially reduce the number of fish through ammocoete  
3 mortality. Project-related effects on flow reductions and effects on water temperatures in all  
4 locations analyzed would be negligible and would not affect river lamprey ammocoete stranding  
5 risk and rearing success. There would be small to substantial beneficial effects from decreased  
6 stranding risk in the Sacramento River at Red Bluff (to -16%), the Feather River (to -41%), and the  
7 American River at Nimbus Dam (to -24%). However, stranding risk under both H1 and H4 in the  
8 Feather River would be higher than those under H3, such that benefits under H3 would not occur  
9 under these limits of the operational range.

10 There would be increases and decreases in ammocoete exposure to elevated temperatures that are  
11 expected to balance out within rivers such that there would be no overall effect.

12 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
13 and quality of rearing habitat for river lamprey would not be affected relative to the CEQA baseline.

### 14 H3/ESO

15 Comparisons of H3 to Existing Conditions for the Sacramento River at Keswick indicate negligible  
16 effects (<5%) or small increases (to 11%) for ammocoete cohort exposures to flow reductions from  
17 50% to 80%, and a more substantial increase in exposure (44%) to 85% flow reduction events  
18 (Table 11-4-130). Comparisons for the Sacramento River at Red Bluff indicate similar results with  
19 negligible effects (<5%) or small increases in exposure (to 12%) for 50% to 80% flow reduction  
20 categories, and a more substantial increase in exposure (from 25 to 50 cohorts or 100%) in the  
21 85% flow reduction category (Table 11-4-131). Based on the prevalence of negligible effects (<5%),  
22 or relatively small increased occurrence of flow reductions for most of the flow reduction categories,  
23 the effects of a more substantial increase in flow reductions in a single flow reduction category  
24 would not be considered biologically meaningful to river lamprey in the Sacramento River.

25 Comparisons for the Trinity River between H3 and Existing Conditions indicated no effect (0%) for  
26 the lower flow reduction categories, up to 70%, and increases in occurrence ranging from 26% to  
27 59% for the 75% through 90% flow reduction categories (Table 11-4-132). The prevalence of  
28 increased occurrence of higher-magnitude flow reductions would affect river lamprey ammocoete  
29 stranding in the Trinity River.

30 Comparisons for the Feather River between H3 and Existing Conditions indicated no effect (0%) or  
31 reductions in frequency of occurrence for all flow reduction categories, with 17% to 48% reductions  
32 in cohorts exposed to 80% to 90% flow reduction events (Table 11-4-133). Decreased occurrences  
33 of flow reductions would have a beneficial effect.

34 Comparisons for the American River at Nimbus Dam (Table 11-4-134) and at the confluence with  
35 the Sacramento River (Table 11-4-135) between H3 and Existing Conditions indicate increased  
36 chance of occurrence of flow reductions between 70 and 90% for Alternative 4 compared to NAA;  
37 meaningful (>5%) predicted increases are from 59 to 416% (increase in cohorts exposed from 25 to  
38 129) for Nimbus Dam and from 20 to 300% (increase in cohorts exposed from 25 to 100) for the  
39 confluence. The prevalence of increased occurrence of higher-magnitude flow reductions would  
40 constitute a biologically meaningful effect on river lamprey ammocoete stranding in the American  
41 River.

42 The number of ammocoete cohorts exposed to 71.6°F under H3 would be higher than those under  
43 Existing Conditions in most locations examined, except in the Sacramento River at Keswick and in

1 the Feather River at the Fish Barrier Dam (Table 11-A1-132). The number of ammocoete cohorts  
2 exposed to 77°F would be similar between Existing Conditions and H3 in the Sacramento, Trinity,  
3 and Stanislaus Rivers, but higher in the Feather and American Rivers.

#### 4 **H1/LOS**

5 There would be generally no differences in mean flows year-round between H1 and H3 in the  
6 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
7 conducted only for the Feather River.

8 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
9 ammocoete cohort exposure between Existing Conditions and H1 at the 50% through 80% flow  
10 reductions (Table 11-4-137). There would be 23% more and 48% fewer cohorts exposed to 85%  
11 and 90% flow reductions, respectively, under H3 relative to Existing Conditions.

12 There would generally be no differences in mean water temperatures year-round between H1 and  
13 H3 in any river examined. As a result, no additional ammocoete temperature cohort exposure  
14 analyses were conducted for H1. Results of these analyses for H1 would be the same as those for H3.

15 Overall, these results indicate that results for H1 would generally be similar to those under H3.

#### 16 **H4/HOS**

17 There would be generally no differences in mean flows year-round between H4 and H3 in the  
18 Sacramento, Trinity, and American rivers. Therefore, ammocoete stranding risk analysis was  
19 conducted only for the Feather River.

20 In the Feather River at Thermalito Afterbay, there would be no or a negligible difference in  
21 ammocoete cohort exposure between Existing Conditions and H4 at the 50% through 80% flow  
22 reductions (Table 11-4-137). There would be 17% and 15% more cohorts exposed to 85% and 90%  
23 flow reductions, respectively, under H3 relative to Existing Conditions.

24 There would generally be no differences in mean water temperatures year-round between H4 and  
25 H3 in any river examined. As a result, no additional ammocoete temperature cohort exposure  
26 analyses were conducted for H4. Results of these analyses for H4 would be the same as those for H3.

27 Overall, these results indicate that results for H4 would generally be similar to those under H3.

#### 28 **Summary of CEQA Conclusion**

29 Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between  
30 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
31 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as  
32 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. There would be  
33 moderate to substantial increases in occurrence of flow reduction events for Alternative 4 with  
34 respect to Existing Conditions for the Trinity River (26% to 59%) and the American River at Nimbus  
35 Dam (59% to 416%) and at the confluence with the Sacramento River (20% to 300%) that would  
36 affect river lamprey ammocoete stranding risk and therefore rearing success for these locations.  
37 There would be a beneficial effect from reduced occurrence of flow reductions in the Feather River  
38 (-17% to 48%) but this effect would not be sufficient to offset the negative effects from increased  
39 occurrence of flow reductions at the other locations. Further, stranding risk under both H1 and H4  
40 in the Feather River would be higher than those under H3, such that benefits under H3 would not

1 occur under these limits of the operational range. There would also be increases under Alternative 4  
 2 in ammocoete cohort exposure to critical water temperatures in all rivers evaluated that would have  
 3 biologically meaningful effects on rearing success through ammocoete mortality. These results are  
 4 primarily caused by four factors: differences in sea level rise, differences in climate change, future  
 5 water demands, and implementation of the alternative. The analysis described above comparing  
 6 Existing Conditions to H3 does not partition the effect of implementation of the alternative from  
 7 those of sea level rise, climate change and future water demands using the model simulation results  
 8 presented in this chapter. However, the increment of change attributable to the alternative is well  
 9 informed by the results from the NEPA analysis, which found this effect to be not adverse. In  
 10 addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation  
 11 period, which does include future sea level rise, climate change, and water demands. Therefore, the  
 12 comparison of results between the alternative and Existing Conditions in the LLT, both of which  
 13 include sea level rise, climate change, and future water demands, isolates the effect of the alternative  
 14 from those of sea level rise, climate change, and water demands.

15 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
 16 term implementation period and H3 indicates that flows in the locations and during the months  
 17 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
 18 indicates that the differences between Existing Conditions and Alternative 4 found above would  
 19 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
 20 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
 21 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
 22 impact on rearing habitat for river lamprey. This impact is found to be less than significant and no  
 23 mitigation is required.

24 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

25 In general, the effect of Alternative 4 on river lamprey migration conditions would be negligible  
 26 relative to the NAA.

27 **H3/ESO**

28 After 3 to 5 years, river lamprey ammocoetes migrate downstream and become macrophthalmia once  
 29 they reach the Delta. River lamprey migration generally occurs September through November  
 30 (USFWS unpublished data). The effects of H3 on seasonal migration flows for river lamprey  
 31 macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration  
 32 pathways of river lamprey during the likely migration period (September through November) were  
 33 examined to predict how H3 may affect migration flows for outmigrating macrophthalmia. Analyses  
 34 were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with the  
 35 Sacramento River, and the American River at the confluence with the Sacramento River.

36 The adult river lamprey upstream migration period also occurs between September and June.  
 37 Therefore, results presented below represent effects to the migration of both macrophthalmia and  
 38 adult river lamprey. CALSIM II flow outputs were examined during these periods for each model  
 39 scenario.

40 *Sacramento River*

41 Mean monthly flow rates for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model*  
 42 *Results utilized in the Fish Analysis*) were examined during the September to November river

1 lamprey macrophthalmia and adult migration periods. Flows under H3 would generally be similar to  
2 flows under NAA during September and October, but up to 18% lower during November depending  
3 on water year type. Because of the relatively small magnitude, reduced flows during November are  
4 not likely to cause biologically meaningful effects on river lamprey migration.

#### 5 *Feather River*

6 Flows in the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
7 *Model Results utilized in the Fish Analysis*) were examined during the September to November river  
8 lamprey macrophthalmia and adult migration periods. Flows under H3 would generally be lower  
9 than flows under NAA during September, higher than flows under NAA during October, and similar  
10 to flows under NAA during November. Based on occurrence of negligible effects or increases in flow  
11 that would have a beneficial effect on migration conditions, with decreases predicted for wetter  
12 water years when effects on migration conditions would not be as critical, these results indicate that  
13 effects of NAA on flows would not have biologically meaningful negative effects on migration  
14 conditions in the Feather River.

#### 15 *American River*

16 Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*  
17 *Model Results utilized in the Fish Analysis*) were examined during the September through November  
18 macrophthalmia and adult migration periods. Flows under H3 would be lower than flows under NAA  
19 during September and November and similar to flows during October. However, flows during  
20 September would only be negative during wetter water years, when reduced flows are less critical  
21 to lamprey migration. Further, flows during November would be only marginally lower (6% to 8%).  
22 Overall, these results indicate that project-related effects would include small decreases in flow for  
23 some months and water year types, but that overall effects throughout the migration period would  
24 not have biologically meaningful effects on river lamprey migration.

#### 25 **H1/LOS**

26 Flows under H1 in the Sacramento River at Red Bluff would be lower than flows under H3 (up to  
27 44% lower) during September and November and similar during October (Appendix 11C, *CALSIM II*  
28 *Model Results utilized in the Fish Analysis*). Flows under H1 in the Feather River at the confluence  
29 with the Sacramento River would generally be similar to flows under H3, except in wet and above  
30 normal water years during September, in which flows would be 65% and 40% lower, respectively.  
31 Flows under H1 in the American River at the confluence with the Sacramento River would generally  
32 be similar to flows under H3, except in wet and above normal water years during September, in  
33 which flows would be 65% and 40% lower, respectively. Overall, migration conditions for river  
34 lamprey under H1 would be less favorable than conditions under H3.

#### 35 **H4/HOS**

36 Flows under H4 in the Sacramento River at Red Bluff would be similar to or greater than flows  
37 under H3 during September through November (Appendix 11C, *CALSIM II Model Results utilized in*  
38 *the Fish Analysis*). Flows under H4 in the Feather River at the confluence with the Sacramento River  
39 would generally be up to 24% lower than flows under H3 in September and October but similar  
40 during November. Flows under H4 in the American River at the confluence with the Sacramento  
41 River would generally be up to 20% greater than flows under H3 during September, up to 13%

1 lower than flows under H3 during October, and similar to flows under H3 during November. Overall,  
2 migration conditions for river lamprey under H4 would be less favorable than conditions under H3.

3 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not  
4 substantially reduce the amount of suitable habitat or substantially interfere with the movement of  
5 fish. H3 would primarily have negligible effects (<5%), small increases or decreases in flow, or  
6 decreases in wetter water year types and/or during a limited portion of the migration period that  
7 would not have negative effects on migration conditions. There would be beneficial effects from  
8 moderate increases in flow for some months and water year types in all locations, including the  
9 Sacramento River (to 18%), the Feather River (to 22%) and the American River (to 16%); however,  
10 the beneficial effect would be partially offset by flow reductions during other months of the  
11 migration periods. Flows under H1 and H4 would be less favorable than those under H3 if water  
12 operations, although neither would cause adverse impacts.

13 **CEQA Conclusion:** In general, under all the Alternative 4 water operations scenarios, the quantity  
14 and quality of migration habitat for river lamprey would not be reduced relative to the CEQA  
15 baseline.

### 16 H3/ESO

17 For the Sacramento River at Red Bluff, comparisons of mean monthly flow rate for H3 to Existing  
18 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable  
19 effects of H3 during September, with increases in mean monthly flow for wetter water year types  
20 (39 to 55%) and decreases for drier water year types (-11 and -14% for below normal and dry  
21 years, respectively). H3 would have negligible effects (<5%) for October in all water years, and  
22 would have negligible effects (<5%) or cause small decreases in mean monthly flows for all water  
23 year types in November (-7 to -14%). Based on small decreases in drier water year types during  
24 September and November, these results indicate that H3 would not have biologically meaningful  
25 negative effects on macrophthalmia migration conditions in the Sacramento River.

26 Comparisons for the Feather River at the confluence with the Sacramento River indicate (Appendix  
27 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable effects of H3 relative to  
28 Existing Conditions based on month and water year type. There would be substantial increases for  
29 wetter years (to 108%) and decreases in drier years (to -28%) during September, variable results  
30 during October with increases to 30% in above normal, dry, and critical years and small decreases  
31 (to -9%) in wet and below normal years, and negligible effects (<5%) or decreases (-20% in wet  
32 years, -8% in below normal years) during November. There would be small to moderate decreases  
33 during all three months in below normal years, however, effects during dry and critical years are  
34 more variable. These results indicate that despite variable effects by month and water year type,  
35 effects of H3 on flow would not have biologically meaningful negative effects on macrophthalmia  
36 migration in the Feather River.

37 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,  
38 *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate  
39 reductions in flow for most months and most water year types, ranging from -16 to -51%, with the  
40 exception of increases in mean monthly flow during October in below normal (26%) and critical  
41 (13%) water years, and negligible decreases (<5%) in above normal and dry years. The  
42 predominance of decreased flows for H3 compared to Existing Conditions would have adverse  
43 effects on migration, with substantial decreases for dry and critical years in September (-39 and -  
44 51%, respectively) and November (-33 and -28%, respectively).

1 **H1/LOS**

2 Flows under H1 in the Sacramento River at Red Bluff would be lower than flows under H3 (up to  
3 44% lower) during September and November and similar during October (Appendix 11C, *CALSIM II*  
4 *Model Results utilized in the Fish Analysis*). Flows under H1 in the Feather River at the confluence  
5 with the Sacramento River would generally be similar to flows under H3, except in wet and above  
6 normal water years during September, in which flows would be 65% and 40% lower, respectively.  
7 Flows under H1 in the American River at the confluence with the Sacramento River would generally  
8 be similar to flows under H3, except in wet and above normal water years during September, in  
9 which flows would be 65% and 40% lower, respectively. Overall, migration conditions for river  
10 lamprey under H1 would be less favorable than conditions under H3.

11 **H4/HOS**

12 Flows under H4 in the Sacramento River at Red Bluff would be similar to or greater than flows  
13 under H3 during September through November (Appendix 11C, *CALSIM II Model Results utilized in*  
14 *the Fish Analysis*). Flows under H4 in the Feather River at the confluence with the Sacramento River  
15 would generally be up to 24% lower than flows under H3 in September and October but similar  
16 during November. Flows under H4 in the American River at the confluence with the Sacramento  
17 River would generally be up to 20% greater than flows under H3 during September, up to 13%  
18 lower than flows under H3 during October, and similar to flows under H3 during November. Overall,  
19 migration conditions for river lamprey under H4 would be less favorable than conditions under H3.

20 **Summary of CEQA Conclusion**

21 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between  
22 the CEQA baseline and Alternative 4 could be significant because, under the CEQA baseline, the  
23 alternative could substantially reduce the amount of suitable habitat and substantially interfere with  
24 the movement of fish, contrary to the NEPA conclusion set forth above. There would be moderate  
25 and persistent flow reductions for substantial portions of the river lamprey macrophthalmia  
26 migration period in the American River, and less persistent and smaller magnitude flow reductions  
27 in the Sacramento River and Feather River. These flow reductions would affect juvenile migration  
28 success, increase straying, and delay access to the ocean. These flow reductions would also affect  
29 adult migration success, including a reduction in the ability for adults to sense olfactory cues if they  
30 use these cues to find natal spawning grounds. There would be beneficial effects from increases in  
31 flow for some months and water year types in each location including in the Sacramento River (to  
32 55% in wetter water years), the Feather River (to 108% in wetter water years and to 30% for drier  
33 water years in October), and the American River (to 26% in October). However, this effect would not  
34 be sufficient to offset the negative effects of flow reductions for the remainder of the migration  
35 period and/or in other water year types, particularly drier water year types when effects of flow  
36 reductions would be more critical. Flows under H1 and H4 would be less favorable than those under  
37 H3.

38 These results are primarily caused by four factors: differences in sea level rise, differences in climate  
39 change, future water demands, and implementation of the alternative. The analysis described above  
40 comparing Existing Conditions to H3 does not partition the effect of implementation of the  
41 alternative from those of sea level rise, climate change and future water demands using the model  
42 simulation results presented in this chapter. However, the increment of change attributable to the  
43 alternative is well informed by the results from the NEPA analysis, which found this effect to be not  
44 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT

1 implementation period, which does include future sea level rise, climate change, and water  
2 demands. Therefore, the comparison of results between the alternative and Existing Conditions in  
3 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the  
4 effect of the alternative from those of sea level rise, climate change, and water demands.

5 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-  
6 term implementation period and H3 indicates that flows in the locations and during the months  
7 analyzed above would generally be similar between Existing Conditions during the LLT and H3. This  
8 indicates that the differences between Existing Conditions and Alternative 4 found above would  
9 generally be due to climate change, sea level rise, and future demand, and not the alternative. As a  
10 result, the CEQA conclusion regarding Alternative 4, if adjusted to exclude sea level rise and climate  
11 change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant  
12 impact on migration conditions for river lamprey. This impact is found to be less than significant and  
13 no mitigation is required.

#### 14 **Restoration Measures (CM2, CM4–CM7, and CM10)**

15 Alternative 4 has the same Restoration Measures as Alternative 1A. Because no substantial  
16 differences in restoration-related fish effects are anticipated anywhere in the affected environment  
17 under Alternative 4 compared to those described in detail for Alternative 1A, the fish effects of  
18 restoration measures described for river lamprey under Alternative 1A (Impacts AQUA-187 through  
19 AQUA-189) also appropriately characterize effects under Alternative 4.

20 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 21 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

#### 22 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River** 23 **Lamprey**

#### 24 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

25 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms  
26 on river lamprey are the same for Alternative 4, as those described under Alternative 1A (Impacts  
27 AQUA 187-through AQUA-189). The effects would not be adverse, and would generally be beneficial.

28 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or  
29 less than significant, and no mitigation is required.

#### 30 **Other Conservation Measures (CM12–CM19 and CM21)**

31 Alternative 4 has the same other conservation measures as Alternative 1A. Because no substantial  
32 differences in other conservation-related fish effects are anticipated anywhere in the affected  
33 environment under Alternative 4 compared to those described in detail for Alternative 1A, the fish  
34 effects of other conservation measures described for river lamprey under Alternative 1A (Impacts  
35 AQUA-190 through AQUA-198) also appropriately characterize effects under Alternative 4.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative 4.

#### 37 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

1 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**  
2 **(CM13)**

3 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

4 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

5 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

6 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

7 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

8 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

9 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**  
10 **(CM21)**

11 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms  
12 on river lamprey are the same as those described under Alternative 1A, Impacts AQUA-190 through  
13 AQUA-198). The effects would not be adverse, and would generally be beneficial.

14 *CEQA Conclusion:* All nine of the impact mechanisms listed above would be at least slightly  
15 beneficial, or less than significant, and no mitigation is required.

## 16 **Non-Covered Aquatic Species of Primary Management Concern**

### 17 **Construction and Maintenance of CM1**

18 The effects of construction and maintenance of CM1 under Alternative 4 would be similar for all  
19 non-covered species; therefore, the analysis below is combined for all non-covered species instead  
20 of analyzed by individual species.

### 21 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered** 22 **Aquatic Species of Primary Management Concern**

23 *NEPA Effects:* Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of  
24 construction of water conveyance facilities on non-covered species of primary management  
25 concern. That discussion under delta smelt addresses the type, magnitude and range of impact  
26 mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects  
27 of the construction of water conveyance facilities under Alternative 4 would be similar to those  
28 described for Alternative 1A (see Alternative 1A, Impact AQUA-1) except that Alternative 4 would  
29 include three intakes compared to five intakes under Alternative 1A, so the effects would be  
30 proportionally less under this alternative. This would convert about 6,360 lineal feet of existing  
31 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and  
32 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and  
33 would require 27.3 acres of dredging. Additionally, California bay shrimp would not be affected  
34 because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are  
35 unlikely to be affected because their primary distributions are upstream.

1 Similar to the conclusion for Alternative 1A, Impact AQUA-1, environmental commitments and  
2 mitigation measures would be available to avoid and minimize potential effects, and the effect would  
3 not be adverse for non-covered aquatic species of primary management concern.

4 **CEQA Conclusion:** Similar to the conclusion for Alternative 1A, Impact AQUA-1, the impact of the  
5 construction of the water conveyance facilities on non-covered aquatic species of primary  
6 management concern would not be significant except for construction noise associated with pile  
7 driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes  
8 would be constructed rather than five. Implementation of Mitigation Measure AQUA-1a and  
9 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**  
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of  
13 Alternative 1A.

14 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**  
15 **and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of  
17 Alternative 1A.

18 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**  
19 **Aquatic Species of Primary Management Concern**

20 **NEPA Effects:** Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of  
21 maintenance of water conveyance facilities on non-covered species of primary management  
22 concern. That discussion under delta smelt addresses the type, magnitude and range of impact  
23 mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects  
24 of the construction of water conveyance facilities under Alternative 4 would be similar to those  
25 described for Alternative 1A (see Alternative 1A, Impact AQUA-2). California bay shrimp would not  
26 be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and  
27 hardhead are unlikely to be affected because their primary distributions are upstream.  
28 Consequently, the effects would not be adverse.

29 **CEQA Conclusion:** Similar to the conclusion for Alternative 1A, Impact AQUA-2, the impact of the  
30 maintenance of water conveyance facilities on non-covered species of primary management concern  
31 would be less than significant and no mitigation is required.

32 **Water Operations of CM1**

33 The effects of water operations of CM1 under Alternative 4 include a detailed analysis of the  
34 following species:

- 35 ● Striped Bass
- 36 ● American Shad
- 37 ● Threadfin Shad
- 38 ● Largemouth Bass

- 1 • Sacramento tule perch
- 2 • Sacramento-San Joaquin roach – California species of special concern
- 3 • Hardhead – California species of special concern

4 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**  
5 **Species of Primary Management Concern**

6 ***Striped Bass***

7 ***NEPA Effects:*** Under Existing Conditions, striped bass are observed in salvage operations of the  
8 south Delta facilities throughout the year, with the majority of juvenile striped bass entrainment  
9 occurring during the summer (May through July). Entrainment losses under Scenario H3 to the  
10 SWP/CVP south Delta intakes would be reduced moderately compared to baseline conditions (NAA)  
11 since exports from the south Delta facilities would be reduced in the summer. Entrainment loss at  
12 the south Delta facilities under Scenario H1 would be similar to conditions under Scenario H3, while  
13 entrainment would be further reduced under Scenario H4. Entrainment of juvenile and adult striped  
14 bass would be limited at the proposed north Delta intakes and the alternate NBA intake by screens  
15 designed to exclude fish larger than 15 mm. Eggs and larvae would be vulnerable as they are  
16 passively transported downstream from spawning areas on the Sacramento River. Agricultural  
17 diversions are potential sources of entrainment for small fish such as larval and juvenile striped  
18 bass. Reduction or consolidation of up to 12% of agricultural diversions in ROAs would not increase  
19 entrainment and may provide a minor benefit for the species. Also larval entrainment is not thought  
20 to have population consequences due to the large fecundity of individual females and the fact that  
21 population levels do not correspond to numbers of larvae (Moyle 2002). In addition, restoration  
22 activities as part of the conservation measures should increase the amount of habitat for young  
23 striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that  
24 these habitat changes would result in at least a minor improvement in production of juvenile striped  
25 bass. Overall, the effect of Alternative 4 on striped bass entrainment would not be adverse and may  
26 benefit the species due to reductions in south Delta entrainment and increases in habitat and food  
27 supply.

28 ***CEQA Conclusion:*** The impact of water operations on entrainment of striped bass would be the  
29 same as described immediately above. The changes in entrainment under Alternative 4 would not  
30 substantially reduce the striped bass population when other conservation measures are taken into  
31 consideration. The impact would be less than significant and no mitigation would be required.

32 ***American Shad***

33 American shad eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP  
34 Delta intakes and the alternate NBA intake as these life stages are passively transported  
35 downstream to the north Delta. Most American shad spawning though takes place well upstream of  
36 the Delta. State-of-the-art fish screens on these north Delta intakes though would exclude juvenile  
37 and adult American shad.

38 ***NEPA Effects:*** American shad entrainment losses would be reduced at the SWP/CVP south Delta  
39 facilities under the flow scenarios for Alternative 4 compared to baseline conditions due to  
40 moderately reduced south delta exports in the summer. Entrainment losses would be further  
41 reduced under Scenario H4 compared to the other flow scenarios. Reduction or consolidation of up  
42 to 12% of agricultural diversions in ROAs would not increase entrainment and may provide a

1 modest benefit to the species. Overall, the effect on American shad would not be adverse, and would  
2 be slightly beneficial.

3 **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the  
4 same as described immediately above. The changes in entrainment under Alternative 4 would not  
5 substantially reduce the American shad population. The impact would be less than significant and  
6 no mitigation would be required.

#### 7 **Threadfin Shad**

8 **NEPA Effects:** The impact and conclusion would be the same as discussed for Alternative 1A (Impact  
9 AQUA-201 for Threadfin Shad). Entrainment at the south delta would be reduced due to overall  
10 decreased exports from the SWP/CVP south Delta facilities. Entrainment losses would be further  
11 reduced under Scenario H4 compared to the other flow scenarios for Alternative 4. There would be  
12 potential entrainment of threadfin shad eggs and larvae to the north Delta intakes, although this risk  
13 is minimal because threadfin shad are most abundant in the south Delta (Baxter et al. 2010).  
14 Decommissioning or consolidation of agricultural diversions in Delta ROAs would potentially reduce  
15 threadfin shad entrainment loss. Overall, threadfin shad entrainment would be reduced because  
16 they are most abundant in the southern Delta and would particularly benefit from reduced south  
17 Delta exports. The effect would not be adverse.

18 **CEQA Conclusion:** The impact of water operations on entrainment of threadfin shad would be the  
19 same as described immediately above. The changes in entrainment under Alternative 4 would not  
20 substantially reduce and may benefit the threadfin shad population. The impact would be less than  
21 significant and no mitigation would be required.

#### 22 **Largemouth Bass**

23 **NEPA Effects:** Since largemouth bass are predominantly found in the south and central portions of  
24 the Delta, largemouth bass would be most vulnerable to entrainment to south Delta facilities.  
25 Entrainment to the south Delta would be reduced under all flow scenarios for Alternative 4 because  
26 of reductions in south Delta exports in the summer. Entrainment loss would be further reduced  
27 under Scenario H4 compared to other Alternative 4 flow scenarios, because of lower south Delta  
28 exports. As discussed for Alternative 1A (Impact AQUA-201 for Largemouth Bass) few larval  
29 largemouth bass would be vulnerable to entrainment to north Delta and alternative NBA intake  
30 since they are not expected to readily occur in the vicinity. Largemouth bass are nest builders and  
31 typically build their nests in quiet, low flow backwaters. Decommissioning or consolidation of up to  
32 12% of Delta agricultural diversions would potentially reduce entrainment of largemouth bass.  
33 Overall entrainment would be reduced under Alternative 4.

34 **CEQA Conclusion:** The impact of water operation on largemouth bass would be as described  
35 immediately above. The changes in entrainment under Alternative 4 could benefit the largemouth  
36 bass population. The impact would be less than significant and no mitigation would be required.

#### 37 **Sacramento Tule Perch**

38 **NEPA Effects:** The effects and conclusion for this impact would be the same as Alternative 1A  
39 (Impact AQUA-201 for Sacramento tule perch). Entrainment of Sacramento tule perch is  
40 documented in small numbers at the SWP/CVP south Delta. Entrainment at the south Delta intakes  
41 would be further minimized under all flow scenarios for Alternative 4, especially Scenario H4. Under  
42 Alternative 4, entrainment would be reduced because north Delta intakes would be screened and

1 south Delta exports would be reduced compared to baseline conditions (NAA). Because Sacramento  
2 tule perch are viviparous, newly born Sacramento tule perch would be large enough to be effectively  
3 screened at the proposed north delta facilities. Reduction or consolidation of agricultural diversions  
4 under the Plan would potentially reduce entrainment of Sacramento tule perch. Overall the  
5 reduction in entrainment of Sacramento tule perch under Alternative 4 would not be adverse.

6 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would  
7 be the same as described immediately above. The changes in entrainment under Alternative 4 would  
8 not substantially reduce the Sacramento tule perch population. The impact would be less than  
9 significant and no mitigation would be required.

#### 10 ***Sacramento-San Joaquin Roach***

11 **NEPA Effects:** The effect of water operations on entrainment of Sacramento-San Joaquin roach  
12 under Alternative 4 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
13 AQUA-201). Also, Sacramento-San Joaquin roach distribution is primarily upstream of the intakes  
14 and south Delta facilities. For a detailed discussion, please see Alternative 1A, Impact AQUA-201.  
15 The effects would not be adverse.

16 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach  
17 would be the same as described immediately above and would be less than significant and no  
18 mitigation would be required.

#### 19 ***Hardhead***

20 **NEPA Effects:** The effect of water operations on entrainment of hardhead under Alternative 4 would  
21 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). Also,  
22 hardhead distribution is primarily upstream of the intakes and south Delta facilities. For a detailed  
23 discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

24 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same  
25 as described immediately above and would be less than significant and no mitigation would be  
26 required.

#### 27 ***California Bay Shrimp***

28 **NEPA Effects:** California bay shrimp do not occur in the vicinity of the intakes so there would be no  
29 entrainment effect on them.

30 **CEQA Conclusion:** California bay shrimp do not occur in the vicinity of the intakes so there would no  
31 entrainment impact on them.

#### 32 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 33 **Non-Covered Aquatic Species of Primary Management Concern**

34 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-  
35 covered species of primary management concern.

#### 36 ***Striped Bass***

37 In general, Alternative 4 would slightly improve the quality and quantity of upstream habitat  
38 conditions for striped bass relative to the NAA.

1 **H3/ESO**

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
4 Clear Creek were examined during the April through June striped bass spawning, embryo  
5 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
6 habitat available for spawning, egg incubation, and rearing.

7 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
8 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
9 *utilized in the Fish Analysis*).

10 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
11 greater than flows under NAA during April through June except in above normal years during April  
12 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
14 April through June except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
15 *Results utilized in the Fish Analysis*).

16 In the Feather River at Thermalito Afterbay, flows under H3 would generally be moderately to  
17 substantially greater than flows under NAA during April through June (Appendix 11C, *CALSIM II*  
18 *Model Results utilized in the Fish Analysis*).

19 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
20 under NAA during April through June regardless of water year type (Appendix 11C, *CALSIM II Model*  
21 *Results utilized in the Fish Analysis*). Flow rates in the San Joaquin and Stanislaus rivers under H3  
22 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that  
23 there would be no differences in flows relative to the NAA.

24 *Water Temperature*

25 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
26 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
27 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
28 range could lead to reduced spawning success and increased egg and larval stress and mortality.  
29 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

30 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
31 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
32 be no temperature related effects in these rivers during the April through June period.

33 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside the  
34 range would be similar to or lower than the percentage under NAA in all water year types (Table 11-  
35 4-138).

1 **Table 11-4-138. Difference and Percent Difference in the Percentage of Months during April–June**  
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**  
 3 **59°F to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial**  
 4 **Rearing<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-3 (-7%)	-8 (-16%)
Above Normal	-18 (-40%)	-15 (-36%)
Below Normal	-17 (-40%)	-19 (-42%)
Dry	-2 (-4%)	1 (2%)
Critical	11 (28%)	-3 (-6%)
All	-5 (-11%)	-8 (-17%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

5

6 **H1/LOS**

7 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
 8 and in Clear Creek during the April through June striped bass spawning, embryo incubation, and  
 9 initial rearing period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
 10 *Results utilized in the Fish Analysis*). The percentage of months under H1 with mean water  
 11 temperatures outside the 59°F to 68°F suitable water temperature range in the Feather River below  
 12 Thermalito Afterbay would be similar to or lower than the percentage under H3 in all water year  
 13 types (Table 11-4-139).

14 **Table 11-4-139. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 15 **Model Scenarios in the Percentage of Months during April–June in Which Water Temperatures in**  
 16 **the Feather River below Thermalito Afterbay Are outside the 59°F to 68°F Water Temperature**  
 17 **Range for Striped Bass Spawning, Embryo Incubation, and Initial Rearing<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (0%)	10 (24%)
Above Normal	-3 (-11%)	18 (67%)
Below Normal	0 (0%)	17 (65%)
Dry	-3 (-7%)	-5 (-11%)
Critical	0 (0%)	-3 (-6%)
All	-2 (-5%)	7 (18%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

18

19 **H4/HOS**

20 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through June  
 21 striped bass spawning, embryo incubation, and initial rearing period would generally be similar to  
 22 flows under H3 except during June, in which flows would be up to 12% lower under H4 (Appendix  
 23 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 in the Feather River at  
 24 Thermalito Afterbay would generally be up to 330% greater than flows under H3 during April and  
 25 May and generally up to 20% lower than flows under H3 during June. Flows under H4 in the

1 American River below Nimbus Dam would generally be similar to flows under H3 during April and  
2 May and generally up to 39% lower than flows under H3 during June. Flows under H4 in the Trinity,  
3 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout  
4 the period. The percentage of months under H4 with mean water temperatures outside the 59°F to  
5 68°F suitable water temperature range in the Feather River below Thermalito Afterbay would be  
6 10% to 18% higher than the percentage under H3 in wet, above normal, and below normal water  
7 years and 3% to 5% lower in dry and critical water years (Table 11-4-139).

8 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
9 Alternative 4 would not cause a substantial reduction in striped bass spawning, incubation, or initial  
10 rearing habitat. Flows in all rivers examined during the April through June spawning, incubation,  
11 and initial rearing period under Alternative 4 would generally be similar to or greater than flows  
12 under the NAA. The percentage of months outside the 59°F to 68°F water temperature range would  
13 generally be lower under Alternative 4 than under the NAA. Flow and water temperature conditions  
14 under H4 would be less favorable than those under H3 if water operations were to shift towards this  
15 end of the adaptive range.

16 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
17 habitat conditions for striped bass relative to Existing Conditions.

### 18 H3/ESO

#### 19 Flows

20 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
21 Clear Creek were examined during the April through June striped bass spawning, embryo  
22 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream  
23 habitat available for spawning, egg incubation, and rearing.

24 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
25 greater than flows under Existing Conditions during April through June, except in wet years during  
26 May (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
28 greater than flows under Existing Conditions during April through June, except in critical years  
29 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
31 Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM  
32 II Model Results utilized in the Fish Analysis*).

33 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
34 Existing Conditions during April through June, except in wet years during May (33% lower)  
35 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
37 flows under Existing Conditions during April and June, except in above normal and below normal  
38 years during April (7% and 6% lower, respectively) and wet and critical years during June (27% and  
39 33% lower, respectively), but generally lower, by up to 29%, during May (Appendix 11C, *CALSIM II  
40 Model Results utilized in the Fish Analysis*). The most persistent flow reductions in drier water year

1 types, when effects would be most critical for habitat conditions, consist of reductions in critical  
2 years during May (15% lower) and June (33% lower).

3 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
4 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
5 reductions in flows during the period relative to Existing Conditions.

#### 6 *Water Temperature*

7 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped  
8 bass spawning, embryo incubation, and initial rearing during April through June was examined in  
9 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this  
10 range could lead to reduced spawning success and increased egg and larval stress and mortality.  
11 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

12 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
13 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
14 be no temperature related effects in these rivers during the April through June period.

15 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside of the  
16 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and  
17 initial rearing during April through June would be lower than the percentage under Existing  
18 Conditions in all water years except critical years (28% higher) (Table 11-4-138). This is a relatively  
19 small effect that would not have biologically meaningful negative effects on the striped bass  
20 population.

#### 21 **H1/LOS**

22 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
23 and in Clear Creek during the April through June striped bass spawning, embryo incubation, and  
24 initial rearing period would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model*  
25 *Results utilized in the Fish Analysis*). The percentage of months under H1 with mean water  
26 temperatures outside the 59°F to 68°F suitable water temperature range in the Feather River below  
27 Thermalito Afterbay would be similar to or lower than the percentage under H3 in all water year  
28 types (Table 11-4-139).

#### 29 **H4/HOS**

30 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through June  
31 striped bass spawning, embryo incubation, and initial rearing period would generally be similar to  
32 flows under H3 except during June, in which flows would be up to 12% lower under H4 (Appendix  
33 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4 in the Feather River at  
34 Thermalito Afterbay would generally be up to 330% greater than flows under H3 during April and  
35 May and generally up to 20% lower than flows under H3 during June. Flows under H4 in the  
36 American River below Nimbus Dam would generally be similar to flows under H3 during April and  
37 May and generally up to 39% lower than flows under H3 during June. Flows under H4 in the Trinity,  
38 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout  
39 the period. The percentage of months under H4 with mean water temperatures outside the 59°F to  
40 68°F suitable water temperature range in the Feather River below Thermalito Afterbay would be  
41 10% to 18% higher than the percentage under H3 in wet, above normal, and below normal water  
42 years and 3% to 5% lower in dry and critical water years (Table 11-4-139).

1 Collectively, these results indicate that the impact would not be significant because Alternative 4  
2 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of  
3 striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and  
4 Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under  
5 Alternative 4 would generally be similar to or greater than flows under Existing Conditions. There  
6 would be isolated and/or small-magnitude flow reductions for some months and water year types  
7 that would not have biologically meaningful negative effects. The most persistent flow reductions  
8 would be small to moderate reductions for two of the three months in the spawning period in the  
9 American River, which would not have biologically meaningful negative effects on the striped bass  
10 population. Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 4,  
11 although this effect would not be biologically meaningful to striped bass. The percentage of months  
12 outside the 59°F to 68°F water temperature range would generally be lower under Alternative 4  
13 than under Existing Conditions. Flow and water temperature conditions under H4 would be less  
14 favorable than those under H3 if water operations were to shift towards this end of the adaptive  
15 range.

#### 16 ***American Shad***

17 In general, Alternative 4 would slightly improve the quality and quantity of upstream habitat  
18 conditions for American shad relative to the NAA.

#### 19 *Flows*

20 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
21 Clear Creek were examined during the April through June American shad adult migration and  
22 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
23 quality for spawning.

24 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
25 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*  
26 *utilized in the Fish Analysis*).

27 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
28 greater than flows under NAA during April through June except in above normal years during April  
29 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
31 April through June except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
32 *Results utilized in the Fish Analysis*).

33 In the Feather River at Thermalito Afterbay, flows under H3 would generally be moderately to  
34 substantially greater than flows under NAA during April through June (Appendix 11C, *CALSIM II*  
35 *Model Results utilized in the Fish Analysis*).

36 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
37 under NAA during April through June regardless of water year type (Appendix 11C, *CALSIM II Model*  
38 *Results utilized in the Fish Analysis*). Flow rates in the San Joaquin and Stanislaus rivers under H3  
39 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that  
40 there would be no differences in flows relative to the NAA.

1 *Water Temperature*

2 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
3 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
4 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
5 reduced spawning success and increased adult migrant stress and mortality. Water temperatures  
6 were not modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 be the  
8 same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no  
9 temperature related effects in these rivers during the April through June period.

10 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside the  
11 60°F to 70°F water temperature range would generally be lower than the percentage under NAA  
12 depending on water year type (Table 11-4-140).

13 **Table 11-4-140. Difference and Percent Difference in the Percentage of Months during April–June**  
14 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**  
15 **60°F to 70°F Water Temperature Range for American Shad Adult Migration and Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-6 (-13%)	-1 (-2%)
Above Normal	-6 (-17%)	-15 (-33%)
Below Normal	0 (0%)	-7 (-18%)
Dry	0 (0%)	-5 (-11%)
Critical	3 (8%)	-3 (-7%)
All	-2 (-5%)	-5 (-12%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

16

17 **H1/LOS**

18 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
19 and in Clear Creek during the April through June American Shad migration and spawning period  
20 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
21 *Fish Analysis*). The percentage of months under H1 with mean water temperatures outside the 60°F  
22 to 70°F suitable water temperature range in the Feather River below Thermalito Afterbay would be  
23 similar to or lower than the percentage under H3 in all water year types (Table 11-4-141).

1 **Table 11-4-141. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months during April–June in Which Water Temperatures in**  
 3 **the Feather River below Thermalito Afterbay Are outside the 60°F to 70°F Water Temperature**  
 4 **Range for American Shad Adult Migration and Spawning<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (0%)	11 (28%)
Above Normal	-3 (-10%)	18 (60%)
Below Normal	0 (0%)	14 (45%)
Dry	-6 (-15%)	-6 (-15%)
Critical	0 (0%)	0 (0%)
All	-2 (-5%)	7 (19%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

5

6 **H4/HOS**

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through June  
 8 American Shad migration and spawning period would generally be similar to flows under H3 except  
 9 during June, in which flows would be up to 12% lower under H4 (Appendix 11C, *CALSIM II Model*  
 10 *Results utilized in the Fish Analysis*). Flows under H4 in the Feather River at Thermalito Afterbay  
 11 would generally be up to 330% greater than flows under H3 during April and May and generally up  
 12 to 20% lower than flows under H3 during June. Flows under H4 in the American River below  
 13 Nimbus Dam would generally be similar to flows under H3 during April and May and generally up to  
 14 39% lower than flows under H3 during June. Flows under H4 in the Trinity, San Joaquin, and  
 15 Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout the period. The  
 16 percentage of months under H4 with mean water temperatures outside the 60°F to 70°F suitable  
 17 water temperature range in the Feather River below Thermalito Afterbay would be 11% to 18%  
 18 higher than the percentage under H3 in wet, above normal, and below normal water years, 6%  
 19 lower in dry water years, and identical in critical water years (Table 11-4-141).

20 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 21 Alternative 4 would not cause a substantial reduction in American shad spawning or adult  
 22 migration. Flows in all rivers examined during the April through June adult migration and spawning  
 23 period under Alternative 4 would generally be similar to or greater than flows under the NAA. The  
 24 percentage of months outside the 60°F to 70°F water temperature range would generally be lower  
 25 under Alternative 4 than under the NAA. Flow and water temperature conditions under H4 would  
 26 be less favorable than those under H3 if water operations were to shift towards this end of the  
 27 adaptive range.

28 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
 29 habitat conditions for American shad relative to Existing Conditions.

30 **H3/ESO**

31 *Flows*

32 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 33 Clear Creek were examined during the April through June American shad adult migration and

1 spawning period. Lower flows could reduce migration ability and instream habitat quantity and  
2 quality for spawning.

3 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
4 greater than flows under Existing Conditions during April through June, except in wet years during  
5 May (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
7 greater than flows under Existing Conditions during April through June, except in critical years  
8 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
10 Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM  
11 II Model Results utilized in the Fish Analysis*).

12 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
13 Existing Conditions during April through June, except in wet years during May (33% lower)  
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
16 flows under Existing Conditions during April and June, except in above normal and below normal  
17 years during April (7% and 6% lower, respectively) and wet and critical years during June (27% and  
18 33% lower, respectively), but generally lower, by up to 29%, during May (Appendix 11C, *CALSIM II  
19 Model Results utilized in the Fish Analysis*). The most persistent flow reductions in drier water year  
20 types, when effects would be most critical for habitat conditions, consist of reductions in critical  
21 years during May (15% lower) and June (33% lower).

22 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
23 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
24 reductions in flows during the period relative to Existing Conditions.

#### 25 *Water Temperature*

26 The percentage of months outside of the 60°F to 70°F water temperature range for American shad  
27 adult migration and spawning during April through June was examined in the Sacramento, Trinity,  
28 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
29 reduced spawning success and increased adult migrant stress and mortality. Water temperatures  
30 were not modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
32 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
33 be no temperature related effects in these rivers during the April through June period.

34 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside of the  
35 60°F to 70°F water temperature range would be similar to or lower than the percentage under  
36 Existing Conditions in all water years except critical years (8% higher) (Table 11-4-140).

#### 37 **H1/LOS**

38 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
39 and in Clear Creek during the April through June American Shad migration and spawning period  
40 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*

1 *Fish Analysis*). The percentage of months under H1 with mean water temperatures outside the 60°F  
2 to 70°F suitable water temperature range in the Feather River below Thermalito Afterbay would be  
3 similar to or lower than the percentage under H3 in all water year types (Table 11-4-141).

#### 4 **H4/HOS**

5 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through June  
6 American Shad migration and spawning period would generally be similar to flows under H3 except  
7 during June, in which flows would be up to 12% lower under H4 (Appendix 11C, *CALSIM II Model*  
8 *Results utilized in the Fish Analysis*). Flows under H4 in the Trinity River below Lewiston Reservoir  
9 and in Clear Creek at Whiskeytown Dam would be similar to flows under H3 throughout the period.  
10 Flows under H4 in the Feather River at Thermalito Afterbay would generally be up to 330% greater  
11 than flows under H3 during April and May and generally up to 20% lower than flows under H3  
12 during June. Flows under H4 in the American River below Nimbus Dam would generally be similar  
13 to flows under H3 during April and May and generally up to 39% lower than flows under H3 during  
14 June. Flows under H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be  
15 similar to flows under H3 throughout the period. The percentage of months under H4 with mean  
16 water temperatures outside the 60°F to 70°F suitable water temperature range in the Feather River  
17 below Thermalito Afterbay would be 11% to 18% higher than the percentage under H3 in wet,  
18 above normal, and below normal water years, 6% lower in dry water years, and identical in critical  
19 water years (Table 11-4-141).

20 Collectively, these results indicate that the impact would not be significant because Alternative 4  
21 would not cause a substantial reduction in American shad adult migration and spawning habitat,  
22 and no mitigation is necessary. Flows in all rivers examined except the San Joaquin and Stanislaus  
23 rivers during the April through June adult migration and spawning period under Alternative 4  
24 would generally be similar to or greater than flows under Existing Conditions. Flows in the San  
25 Joaquin and Stanislaus rivers would be lower under Alternative 4, although this effect would be  
26 biologically meaningful to American shad. The percentage of months outside the 60°F to 70°F water  
27 temperature range would generally be similar to or lower under Alternative 4 than under Existing  
28 Conditions. Flow and water temperature conditions under H4 would be less favorable than those  
29 under H3 if water operations were to shift towards this end of the adaptive range.

#### 30 ***Threadfin Shad***

31 In general, Alternative 4 would not affect the quality and quantity of upstream habitat conditions for  
32 threadfin shad relative to the NAA.

#### 33 **H3/ESO**

##### 34 *Flows*

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
36 Clear Creek were examined during April through August threadfin shad spawning period. Lower  
37 flows could reduce the quantity and quality of instream habitat available for spawning.

38 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
39 greater than flows under NAA during April through August except in dry years during July (7%  
40 lower) and in dry and critical years during August (to 14% lower) (Appendix 11C, *CALSIM II Model*  
41 *Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
2 greater than flows under NAA during April through August except in above normal years during  
3 April and in critical years during August (both 11% lower) (Appendix 11C, *CALSIM II Model Results*  
4 *utilized in the Fish Analysis*).

5 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
6 April through August except in critical years during June (8% lower) (Appendix 11C, *CALSIM II*  
7 *Model Results utilized in the Fish Analysis*).

8 In the Feather River at Thermalito Afterbay, flows under H3 would be moderately to substantially  
9 greater than flows under NAA during April through June, and lower than flows under NAA during  
10 July and August (to 50% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
11 Based on occurrence late in the spawning period, and the fact that they would be partially offset by  
12 flow increases in the prior months, these flow reductions are not expected to have biologically  
13 meaningful effects.

14 In the American River below Nimbus Dam, flows under H3 would be similar to or greater than flows  
15 under NAA during April through August regardless of water year type except in dry years during  
16 July (12% lower) and in drier water year types during August (to 24%) (Appendix 11C, *CALSIM II*  
17 *Model Results utilized in the Fish Analysis*). These flow reductions are small to moderate magnitude  
18 and limited to late in the spawning period and, therefore, would not have biologically meaningful  
19 negative effects.

20 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
21 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
22 relative to the NAA.

### 23 *Water Temperature*

24 The percentage of months below 68°F water temperature threshold for the April through August  
25 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
26 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful  
27 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear  
28 Creek.

29 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
30 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
31 be no temperature-related effects in these rivers throughout the year.

32 In the Feather River below Thermalito Afterbay, the percentage of months under H3 below 68°F  
33 would be greater than those under NAA (11% to 22% greater) in all but dry and critical years (Table  
34 11-4-142). These are relatively small increases that would not have biologically meaningful effects.

1 **Table 11-4-142. Difference and Percent Difference in the Percentage of Months during April–**  
 2 **August in Which Water Temperatures in the Feather River below Thermalito Afterbay fall below**  
 3 **the 68°F Water Temperature Threshold for Threadfin Shad Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-8 (-12%)	5 (11%)
Above Normal	-20 (-26%)	9 (19%)
Below Normal	-14 (-20%)	10 (22%)
Dry	-36 (-48%)	-6 (-12%)
Critical	-28 (-44%)	0 (0%)
All	-20 (-29%)	3 (7%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **H1/LOS**

6 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
 7 and in Clear Creek during the April through August threadfin shad spawning period would generally  
 8 be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
 9 The percentage of months under H1 with mean water temperatures outside the 59°F to 68°F  
 10 suitable water temperature range in the Feather River below Thermalito Afterbay would be similar  
 11 to the percentage under H3 in all water year types (Table 11-4-143).

12 **Table 11-4-143. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 13 **Model Scenarios in the Percentage of Months during April–June in Which Water Temperatures in**  
 14 **the Feather River below Thermalito Afterbay fall below the 68°F Water Temperature Threshold**  
 15 **for Threadfin Shad Spawning<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (0%)	-6 (-11%)
Above Normal	-2 (-3%)	-9 (-16%)
Below Normal	-1 (-3%)	-4 (-8%)
Dry	1 (3%)	2 (6%)
Critical	0 (0%)	0 (0%)
All	0 (0%)	-3 (-7%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

16

17 **H4/HOS**

18 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through August  
 19 threadfin shad spawning period would generally be similar to flows under H3 except during June, in  
 20 which flows would be up to 12% lower under H4, and during August, in which flows would be up to  
 21 13% greater under H4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
 22 under H4 in the Feather River at Thermalito Afterbay would generally be up to 330% greater than  
 23 flows under H3 during April and May and generally up to 39% lower than flows under H3 during  
 24 June through August. Flows under H4 in the American River below Nimbus Dam would generally be  
 25 similar to flows under H3 except during June in which flows would be up to 39% lower than flows

1 under H3, and during August, in which flows would be up to 32% greater than flows under H3.  
2 Flows under H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar  
3 to flows under H3 throughout the period. The percentage of months under H4 with mean water  
4 temperatures below the 68°F temperature threshold in the Feather River below Thermalito  
5 Afterbay would be similar to or lower than the percentage under H3 in all water years (Table 11-4-  
6 143).

7 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
8 Alternative 4 would not cause a substantial reduction in threadfin shad spawning habitat. Flows in  
9 all rivers examined during the April through August spawning period under Alternative 4 would  
10 generally be similar to or greater than flows under the NAA. Small to substantial flow reductions  
11 would occur in the Feather River during July and August, but would be offset by increases in flows  
12 during the preceding months. In all other locations the occurrence of flow reductions would not be  
13 of sufficient magnitude or frequency to have a biologically meaningful effect on threadfin shad. The  
14 percentage of years below the spawning temperature threshold would be moderately higher under  
15 Alternative 4 relative to the NAA, but this increase is not expected to have a biologically meaningful  
16 effect on the threadfin shad population because there are no temperature-related effects in any  
17 other rivers. Flow conditions in the Feather River under H4 would be less favorable than those  
18 under H3 if water operations were to shift towards this end of the adaptive range.

19 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
20 habitat conditions for threadfin shad relative to Existing Conditions.

### 21 H3/ESO

#### 22 Flows

23 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
24 Clear Creek were examined during April through August spawning period. Lower flows could reduce  
25 the quantity and quality of instream habitat available for spawning.

26 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
27 greater than flows under Existing Conditions during April through August, except in wet years  
28 during May (17% lower), in critical years during July (8% lower), and in wet, dry and critical years  
29 during August (5%, 11%, and 26% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
30 *Analysis*). These are relatively small-magnitude and infrequent flow reductions and would not have  
31 biologically meaningful effects.

32 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
33 greater than flows under Existing Conditions during April through August, except in critical years  
34 during May and August (6% and 33% lower, respectively) and in wet years during July (14% lower)  
35 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
37 Existing Conditions during April through August regardless of water year type except in critical  
38 years during August (25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
39 *Analysis*).

40 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
41 Existing Conditions during April through June, except in wet years during May (33% lower), and in  
42 wetter years during July and August, and would be lower than flows under Existing Conditions in

1 drier water years during July (to 61% lower) and August (to 47% lower) (Appendix 11C, *CALSIM II*  
2 *Model Results utilized in the Fish Analysis*).

3 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
4 flows under Existing Conditions during April and June, except in above normal and below normal  
5 years during April (7% and 6% lower, respectively) and wet and critical years during June (27% and  
6 33% lower, respectively), but generally lower, by up to 48%, during May, July, and August  
7 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The most persistent flow  
8 reductions in drier water year types, when effects would be most critical for habitat conditions,  
9 would be inconsistent and of relatively small magnitude, and/or would occur for two months in a  
10 row during July and August at the end of the spawning period, and therefore would not have  
11 biologically meaningful negative effects.

12 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
13 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
14 reductions in flows during the period relative to Existing Conditions.

#### 15 *Water Temperature*

16 The percentage of months below 68°F water temperature threshold for the April through August  
17 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,  
18 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful  
19 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear  
20 Creek.

21 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
22 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
23 be no temperature-related effects in these rivers during the April through November period.

24 In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water  
25 temperature threshold for threadfin shad spawning under H3 would be 12% to 48% lower than the  
26 percentage under Existing Conditions, depending on water year type (Table 11-4-142).

#### 27 **H1/LOS**

28 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
29 and in Clear Creek during the April through August threadfin shad spawning period would generally  
30 be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
31 The percentage of months under H1 with mean water temperatures outside the 59°F to 68°F  
32 suitable water temperature range in the Feather River below Thermalito Afterbay would be similar  
33 to the percentage under H3 in all water year types (Table 11-4-143).

#### 34 **H4/HOS**

35 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through August  
36 threadfin shad spawning period would generally be similar to flows under H3 except during June, in  
37 which flows would be up to 12% lower under H4, and during August, in which flows would be up to  
38 13% greater under H4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
39 under H4 in the Feather River at Thermalito Afterbay would generally be up to 330% greater than  
40 flows under H3 during April and May and generally up to 39% lower than flows under H3 during  
41 June through August. Flows under H4 in the American River below Nimbus Dam would generally be

1 similar to flows under H3 except during June in which flows would be up to 39% lower than flows  
2 under H3, and during August, in which flows would be up to 32% greater than flows under H3.  
3 Flows under H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar  
4 to flows under H3 throughout the period. The percentage of months under H4 with mean water  
5 temperatures below the 68°F temperature threshold in the Feather River below Thermalito  
6 Afterbay would be similar to or lower than the percentage under H3 in all water years (Table 11-4-  
7 143). Collectively, these results indicate that the impact would not be significant because Alternative  
8 4 would not cause a substantial reduction in threadfin shad spawning habitat, and no mitigation is  
9 necessary. Flows in most rivers examined during the April through August spawning period under  
10 Alternative 4 would generally be similar to or greater than flows under Existing Conditions. There  
11 would be substantial flow reductions during July and August in drier water years in the Feather  
12 River that would have a localized effect late in the spawning season. There would be flow reductions  
13 for some months and some of the drier water year types from May through August in the American  
14 River, but the flow reductions would be offset by increases in adjoining months and/or would not be  
15 of sufficient magnitude or frequency to cause a biologically meaningful effect on threadfin shad.  
16 Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 4, although these  
17 reductions would not have population-level effects on American shad. The percentage of months  
18 outside all temperature thresholds are lower under Alternative 4 than under Existing Conditions,  
19 indicating that there would be a net temperature-related benefit of Alternative 4 to threadfin shad.  
20 Flow conditions in the Feather River under H4 would be less favorable than those under H3 if water  
21 operations were to shift towards this end of the adaptive range.

## 22 **Largemouth Bass**

23 In general, Alternative 4 would not affect the quality and quantity of upstream habitat conditions for  
24 largemouth bass relative to the NAA.

## 25 **H3/ESO**

### 26 *Flows*

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
28 Clear Creek were examined during the March through June largemouth bass spawning period.  
29 Lower flows could reduce the quantity and quality of instream spawning habitat.

30 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
31 greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
32 *utilized in the Fish Analysis*).

33 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
34 greater than flows under NAA during March through June except in above normal years during April  
35 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
37 March through June except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
38 *Results utilized in the Fish Analysis*).

39 In the Feather River at Thermalito Afterbay, flows under H3 would generally be moderately to  
40 substantially greater than flows under NAA during March through June except in below normal  
41 years during March (20% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
42 *Analysis*).

1 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
2 under NAA during March through June regardless of water year type except in dry and critical years  
3 during March (5% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*  
4 *the Fish Analysis*).

5 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
6 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
7 relative to the NAA.

8 *Water Temperature*

9 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
10 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
11 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
12 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear  
13 Creek.

14 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
15 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
16 be no temperature-related effects in these rivers during the March through June period.

17 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside the  
18 59°F to 75°F water temperature range would be similar to or lower than the percentage under NAA  
19 in all water years except dry years (7% higher) (Table 11-4-144).

20 **Table 11-4-144. Difference and Percent Difference in the Percentage of Months during March–**  
21 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Would Be**  
22 **outside the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-9 (-16%)	0 (0%)
Above Normal	-16 (-32%)	-2 (-6%)
Below Normal	-11 (-24%)	0 (0%)
Dry	-16 (-34%)	2 (7%)
Critical	-15 (-34%)	-4 (-12%)
All	-13 (-27%)	-1 (-3%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

23

24 **H1/LOS**

25 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
26 and in Clear Creek during the March through June largemouth bass spawning period would  
27 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
28 *Analysis*). The percentage of months under H1 outside the 59°F to 75°F water temperature range in  
29 the Feather River below Thermalito Afterbay would be similar to the percentage under H3 in all  
30 water year types (Table 11-4-145).

1 **Table 11-4-145. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months during April–June in Which Water Temperatures in**  
 3 **the Feather River below Thermalito Afterbay Would Be outside the 59°F to 75°F Water**  
 4 **Temperature Range for Largemouth Bass Spawning<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (0%)	4 (9%)
Above Normal	-2 (-6%)	9 (26%)
Below Normal	-2 (-6%)	5 (15%)
Dry	-2 (-6%)	-3 (-10%)
Critical	0 (0%)	-4 (-14%)
All	-1 (-3%)	3 (8%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

5

6 **H4/HOS**

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the March through June  
 8 largemouth bass spawning period would generally be similar to flows under H3 except during June,  
 9 in which flows would be up to 12% lower under H4 (Appendix 11C, *CALSIM II Model Results utilized*  
 10 *in the Fish Analysis*). Flows under H4 in the Feather River at Thermalito Afterbay would generally be  
 11 similar to flows under H3 during March, up to 330% greater than flows under H3 during April and  
 12 May, and generally up to 39% lower than flows under H3 during June. Flows under H4 in the  
 13 American River below Nimbus Dam would generally be similar to flows under H3 except during  
 14 June in which flows would be up to 39% lower than flows under H3. Flows under H4 in the Trinity,  
 15 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout  
 16 the period. The percentage of months under H4 with mean water temperatures below outside the  
 17 59°F to 75°F water temperature range in the Feather River below Thermalito Afterbay would be  
 18 similar to the percentage under H3 in all water years except above and below normal water years in  
 19 which the percentages under H4 would be 9% and 5% higher than those under H3 (Table 11-4-  
 20 143). These small increases would not cause biologically meaningful effects to largemouth bass  
 21 spawning habitat conditions.

22 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 23 Alternative 4 would not cause a substantial reduction in largemouth bass spawning habitat. Flows in  
 24 all rivers examined during the March through June spawning period under Alternative 4 would  
 25 generally be similar to or greater than flows under the NAA. The occurrence of flow reductions  
 26 would not be of sufficient magnitude or frequency to have a biologically meaningful effect on  
 27 largemouth bass. The percentage of years outside the suitable spawning temperature range under  
 28 Alternative 4 would be similar to the NAA and there are no differences in water temperatures  
 29 between the NAA and Alternative 4 in all other rivers and creeks examined.

30 **CEQA Conclusion:** In general, Alternative 4 would not reduce the quality and quantity of upstream  
 31 habitat conditions for largemouth bass relative to Existing Conditions.

1 **H3/ESO**

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
4 Clear Creek were examined during the March through June largemouth bass spawning period.  
5 Lower flows could reduce the quantity and quality of instream spawning habitat.

6 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
7 greater than flows under Existing Conditions during March through June, except in below normal  
8 years during March (10% lower) and in wet years during May (17% lower) (Appendix 11C, *CALSIM*  
9 *II Model Results utilized in the Fish Analysis*).

10 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
11 greater than flows under Existing Conditions during March through June, except in below normal  
12 years during March (6% lower) and in critical years during May (6% lower) (Appendix 11C, *CALSIM*  
13 *II Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
15 Existing Conditions during March through June regardless of water year type (Appendix 11C,  
16 *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
18 Existing Conditions during March through June, except in below normal years during March (53%  
19 lower) and in wet years during May (33% lower) (Appendix 11C, *CALSIM II Model Results utilized in*  
20 *the Fish Analysis*).

21 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
22 flows under Existing Conditions during March, April and June, except in critical years during March  
23 (7% lower), above and below normal years during April (7% and 6% lower, respectively), and in  
24 wet and critical years during June (27% and 33% lower, respectively) (Appendix 11C, *CALSIM II*  
25 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be similar to or lower  
26 than flows under Existing Conditions during May (to 29% lower) except in dry years (Appendix 11C,  
27 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when  
28 effects on habitat conditions would be more critical, would be inconsistent and/or of small  
29 magnitude throughout the spawning period and would not have biologically meaningful negative  
30 effects.

31 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
32 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
33 reductions in flows during the period relative to Existing Conditions.

34 *Water Temperature*

35 The percentage of months outside of the 59°F to 75°F suitable water temperature range for  
36 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,  
37 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to  
38 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear  
39 Creek.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
2 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
3 be no temperature-related effects in these rivers during the March through June period.

4 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside of the  
5 59°F to 75°F water temperature range for largemouth bass spawning would be lower than the  
6 percentage under Existing Conditions in all water years (Table 11-4-144).

#### 7 **H1/LOS**

8 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
9 and in Clear Creek during the March through June largemouth bass spawning period would  
10 generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
11 *Analysis*). The percentage of months under H1 outside the 59°F to 75°F water temperature range in  
12 the Feather River below Thermalito Afterbay would be similar to the percentage under H3 in all  
13 water year types (Table 11-4-145).

#### 14 **H4/HOS**

15 Flows under H4 in the Sacramento River upstream of Red Bluff during the March through June  
16 largemouth bass spawning period would generally be similar to flows under H3 except during June,  
17 in which flows would be up to 12% lower under H4 (Appendix 11C, *CALSIM II Model Results utilized*  
18 *in the Fish Analysis*). Flows under H4 in the Feather River at Thermalito Afterbay would generally be  
19 similar to flows under H3 during March, up to 330% greater than flows under H3 during April and  
20 May, and generally up to 39% lower than flows under H3 during June. Flows under H4 in the  
21 American River below Nimbus Dam would generally be similar to flows under H3 except during  
22 June in which flows would be up to 39% lower than flows under H3. Flows under H4 in the Trinity,  
23 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout  
24 the period. The percentage of months under H4 with mean water temperatures below outside the  
25 59°F to 75°F water temperature range in the Feather River below Thermalito Afterbay would be  
26 similar to the percentage under H3 in all water years except above and below normal water years in  
27 which the percentages under H4 would be 9% and 5% higher than those under H3 (Table 11-4-  
28 143). These small increases would not cause biologically meaningful effects to largemouth bass  
29 spawning habitat conditions.

30 Collectively, these results indicate that the impact would not be significant because Alternative 4  
31 would not cause a substantial reduction in largemouth bass spawning habitat, and no mitigation is  
32 necessary. Flows in all rivers examined except the San Joaquin and Stanislaus rivers during the  
33 March through June spawning period under Alternative 4 would generally be similar to or greater  
34 than flows under Existing Conditions. Flows in the San Joaquin and Stanislaus rivers would be lower  
35 under Alternative 4, although these reductions would not have population-level effects on  
36 largemouth bass. The percentage of months outside the 59°F to 75°F water temperature range  
37 would generally be lower under Alternative 4 than under Existing Conditions.

#### 38 **Sacramento Tule Perch**

39 **NEPA Effects:** The effects of water operations on spawning habitat for Sacramento tule perch under  
40 Alternative 4 would be similar to that described for Alternative 1A. For a detailed discussion, please  
41 see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

1 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-202 the impacts on Sacramento  
2 tule perch spawning would be not be significant and no mitigation is required.

3 **Sacramento-San Joaquin Roach – California species of special concern**

4 In general, Alternative 4 would not affect the quality and quantity of upstream habitat conditions for  
5 Sacramento-San Joaquin roach relative to the NAA.

6 **H3/ESO**

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
9 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
10 period. Lower flows could reduce the quantity and quality of instream habitat available for  
11 spawning.

12 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
13 greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*  
14 *utilized in the Fish Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
16 greater than flows under NAA during March through June except in above normal years during April  
17 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
19 March through June except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
20 *Results utilized in the Fish Analysis*).

21 In the Feather River at Thermalito Afterbay, flows under H3 would generally be moderately to  
22 substantially greater than flows under NAA during March through June except in below normal  
23 years during March (20% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*  
24 *Analysis*).

25 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
26 under NAA during March through June regardless of water year type except in dry and critical years  
27 during March (5% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*  
28 *the Fish Analysis*).

29 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
30 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
31 relative to the NAA.

32 *Water Temperature*

33 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
34 Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
35 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
36 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
37 River or Clear Creek.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
2 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
3 be no temperature-related effects in these rivers during the March through June period.

4 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures  
5 would be below the 60.8°F water temperature threshold for roach spawning initiation under H3  
6 would be similar to or lower than the percentage under NAA in all water years (Table 11-4-146).

7 **Table 11-4-146. Difference and Percent Difference in the Percentage of Months during March–**  
8 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the**  
9 **60.8°F Water Temperature Threshold for the Initiation of Sacramento-San Joaquin Roach**  
10 **Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-12%)	0 (0%)
Below Normal	-4 (-7%)	2 (4%)
Dry	-11 (-20%)	0 (0%)
Critical	-17 (-30%)	-2 (-5%)
All	-11 (-18%)	0 (0%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

11  
12 **H1/LOS**

13 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
14 and in Clear Creek during the March through June Sacramento-San Joaquin roach spawning period  
15 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
16 *Fish Analysis*). The percentage of months under H1 below the 60.8°F water temperature threshold in  
17 the Feather River below Thermalito Afterbay would be similar to the percentage under H3 in all  
18 water year types (Table 11-4-147).

19 **Table 11-4-147. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
20 **Model Scenarios in the Percentage of Months during April–June in Which Water Temperatures in**  
21 **the Feather River below Thermalito Afterbay Would Fall below the 60.8°F Water Temperature**  
22 **Threshold for Sacramento-San Joaquin Roach Spawning<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (0%)	4 (7%)
Above Normal	0 (0%)	2 (5%)
Below Normal	0 (0%)	2 (4%)
Dry	-1 (-3%)	0 (0%)
Critical	0 (0%)	0 (0%)
All	0 (-1%)	2 (4%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

1 **H4/HOS**

2 Flows under H4 in the Sacramento River upstream of Red Bluff during the March through June  
3 Sacramento-San Joaquin roach spawning period would generally be similar to flows under H3  
4 except during June, in which flows would be up to 12% lower under H4 (Appendix 11C, *CALSIM II*  
5 *Model Results utilized in the Fish Analysis*). Flows under H4 in the Feather River at Thermalito  
6 Afterbay would generally be similar to flows under H3 during March, up to 330% greater than flows  
7 under H3 during April and May, and generally up to 39% lower than flows under H3 during June.  
8 Flows under H4 in the American River below Nimbus Dam would generally be similar to flows under  
9 H3 except during June in which flows would be up to 39% lower than flows under H3. Flows under  
10 H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows  
11 under H3 throughout the period. The percentage of months under H4 with mean water  
12 temperatures below the 60.8°F water temperature range in the Feather River below Thermalito  
13 Afterbay would be similar to the percentage under H3 in all water years (Table 11-4-147).

14 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
15 Alternative 4 would not cause a substantial reduction in roach spawning habitat. Flows in all rivers  
16 examined during the March through June spawning period under Alternative 4 would generally be  
17 similar to or greater than flows under the NAA. The occurrence of flow reductions would not be of  
18 sufficient magnitude or frequency to have a biologically meaningful effect on roach. The percentage  
19 of years below the spawning temperature threshold under Alternative 4 would be similar to the  
20 NAA and there are no differences in water temperatures between the NAA and Alternative 4 in all  
21 other rivers and creeks examined.

22 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
23 habitat conditions for Sacramento-San Joaquin Roach relative to Existing Conditions.

24 **H3/ESO**

25 *Flows*

26 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
27 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning  
28 period. Lower flows could reduce the quantity and quality of instream habitat available for  
29 spawning.

30 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
31 greater than flows under Existing Conditions during March through June, except in below normal  
32 years during March (10% lower) and in wet years during May (17% lower) (Appendix 11C, *CALSIM*  
33 *II Model Results utilized in the Fish Analysis*).

34 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
35 greater than flows under Existing Conditions during March through June, except in below normal  
36 years during March (6% lower) and in critical years during May (6% lower) (Appendix 11C, *CALSIM*  
37 *II Model Results utilized in the Fish Analysis*).

38 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
39 Existing Conditions during March through June regardless of water year type (Appendix 11C,  
40 *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
2 Existing Conditions during March through June, except in below normal years during March (53%  
3 lower) and in wet years during May (33% lower) (Appendix 11C, *CALSIM II Model Results utilized in*  
4 *the Fish Analysis*).

5 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
6 flows under Existing Conditions during March, April and June, except in critical years during March  
7 (7% lower), above and below normal years during April (7% and 6% lower, respectively), and in  
8 wet and critical years during June (27% and 33% lower, respectively) (Appendix 11C, *CALSIM II*  
9 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be similar to or lower  
10 than flows under Existing Conditions during May (to 29% lower) except in dry years (Appendix 11C,  
11 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when  
12 effects on habitat conditions would be more critical, would be inconsistent and/or of small  
13 magnitude throughout the spawning period and would not have biologically meaningful negative  
14 effects.

15 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
16 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
17 reductions in flows during the period relative to Existing Conditions.

#### 18 *Water Temperature*

19 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San  
20 Joaquin roach spawning initiation during March through June was examined in the Sacramento,  
21 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could  
22 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin  
23 River or Clear Creek.

24 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
25 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
26 be no temperature-related effects in these rivers during the March through June period.

27 In the Feather River below Thermalito Afterbay, the percentage of months under H3 in which  
28 temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation  
29 would be lower than the percentage under Existing Conditions in all water years (Table 11-4-146).

#### 30 **H1/LOS**

31 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
32 and in Clear Creek during the March through June Sacramento-San Joaquin roach spawning period  
33 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
34 *Fish Analysis*). The percentage of months under H1 below the 60.8°F water temperature threshold in  
35 the Feather River below Thermalito Afterbay would be similar to the percentage under H3 in all  
36 water year types (Table 11-4-147).

#### 37 **H4/HOS**

38 Flows under H4 in the Sacramento River upstream of Red Bluff during the March through June  
39 Sacramento-San Joaquin roach spawning period would generally be similar to flows under H3  
40 except during June, in which flows would be up to 12% lower under H4 (Appendix 11C, *CALSIM II*  
41 *Model Results utilized in the Fish Analysis*). Flows under H4 in the Feather River at Thermalito

1 Afterbay would generally be similar to flows under H3 during March, up to 330% greater than flows  
2 under H3 during April and May, and generally up to 39% lower than flows under H3 during June.  
3 Flows under H4 in the American River below Nimbus Dam would generally be similar to flows under  
4 H3 except during June in which flows would be up to 39% lower than flows under H3. Flows under  
5 H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows  
6 under H3 throughout the period. The percentage of months under H4 with mean water  
7 temperatures below the 60.8°F water temperature range in the Feather River below Thermalito  
8 Afterbay would be similar to the percentage under H3 in all water years (Table 11-4-147).

9 Collectively, these results indicate that the impact would not be significant because Alternative 4  
10 would not cause a substantial reduction in Sacramento-San Joaquin roach spawning habitat, and no  
11 mitigation is necessary. Flows in all rivers examined except the San Joaquin and Stanislaus rivers  
12 during the March through June spawning period under Alternative 4 would generally be similar to  
13 or greater than flows under Existing Conditions. Flows in the San Joaquin and Stanislaus rivers  
14 would be lower under Alternative 4, although these reductions would not have population-level  
15 effects on roach. The percentage of months below the 60.8°F water temperature threshold would  
16 generally be lower under Alternative 4 than under Existing Conditions.

#### 17 ***Hardhead – California species of special concern***

18 In general, Alternative 4 would not affect the quality and quantity of upstream habitat conditions for  
19 hardhead relative to the NAA.

#### 20 **H3/ESO**

##### 21 *Flows*

22 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
23 Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
24 could reduce the quantity and quality of instream habitat available for spawning.

25 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
26 greater than flows under NAA during April and May) (Appendix 11C, *CALSIM II Model Results utilized*  
27 *in the Fish Analysis*).

28 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
29 greater than flows under NAA during April and May except during April compared to NAA (11%  
30 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
32 April and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 In the Feather River at Thermalito Afterbay, flows under H3 would generally be moderately to  
34 substantially greater than flows under NAA during April and May (Appendix 11C, *CALSIM II Model*  
35 *Results utilized in the Fish Analysis*).

36 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
37 under NAA during April and May regardless of water year type (Appendix 11C, *CALSIM II Model*  
38 *Results utilized in the Fish Analysis*).

1 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
2 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
3 relative to the NAA.

4 *Water Temperature*

5 The percentage of years outside of the 59°F to 64°F suitable water temperature range for hardhead  
6 spawning during April through May was examined in the Sacramento, Trinity, Feather, American,  
7 and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning  
8 success and increased egg and larval stress and mortality. Water temperatures were not modeled in  
9 the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
11 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
12 be no temperature-related effects in these rivers throughout the year.

13 In the Feather River below Thermalito Afterbay, the percentage of years under H3 outside the 59°F  
14 to 64°F suitable water temperature range would be similar to or lower than the percentage under  
15 NAA in all water year types (Table 11-4-148).

16 **Table 11-4-148. Difference and Percent Difference in the Percentage of Months during April–May**  
17 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Would Be outside**  
18 **the 59°F to 64°F Water Temperature Range for Hardhead Spawning<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-2 (-3%)	-3 (-5%)
Above Normal	-19 (-30%)	-10 (-18%)
Below Normal	18 (42%)	-3 (-5%)
Dry	-9 (-16%)	-3 (-6%)
Critical	-4 (-7%)	-4 (-7%)
All	-2 (-4%)	-4 (-7%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

19

20 **H1/LOS**

21 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
22 and in Clear Creek during the April through May hardhead spawning period would generally be  
23 similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The  
24 percentage of months under H1 outside the 59°F to 64°F suitable water temperature range in the  
25 Feather River below Thermalito Afterbay would be similar to the percentage under H3 in all water  
26 year types (Table 11-4-149).

1 **Table 11-4-149. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months during April–May in Which Water Temperatures in**  
 3 **the Feather River below Thermalito Afterbay Would Fall outside the 59°F to 64°F Water**  
 4 **Temperature Range for Hardhead Spawning<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (0%)	5 (8%)
Above Normal	-4 (-9%)	10 (22%)
Below Normal	0 (0%)	0 (0%)
Dry	-3 (-6%)	-3 (-6%)
Critical	4 (8%)	0 (0%)
All	-1 (-2%)	2 (4%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

5

6 **H4/HOS**

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through May period  
 8 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*  
 9 *Fish Analysis*). Flows under H4 in the Feather River at Thermalito Afterbay would up to 330%  
 10 greater than flows under H3 during April and May. Flows under H4 in the Trinity, American, San  
 11 Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout the  
 12 period. The percentage of months under H4 with mean water temperatures outside the 59°F to 64°F  
 13 suitable water temperature range in the Feather River below Thermalito Afterbay would be similar  
 14 to the percentage under H3 in all water years (Table 11-4-149).

15 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 16 Alternative 4 would not cause a substantial reduction in roach spawning habitat. Flows in all rivers  
 17 examined during the April through May spawning period under Alternative 4 would generally be  
 18 similar to or greater than flows under the NAA. The percentage of years below the spawning  
 19 temperature threshold under Alternative 4 would be similar to the NAA and there are no differences  
 20 in water temperatures between the NAA and Alternative 4 in all other rivers and creeks examined.

21 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
 22 habitat conditions for hardhead relative to Existing Conditions.

23 **H3/ESO**

24 *Flows*

25 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
 26 Clear Creek were examined during the April through May hardhead spawning period. Lower flows  
 27 could reduce the quantity and quality of instream habitat available for spawning.

28 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
 29 greater than flows under Existing Conditions during April through May, except in wet years during  
 30 May (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
 32 greater than flows under Existing Conditions during April through May, except in critical years  
 33 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
2 Existing Conditions during April through May regardless of water year type (Appendix 11C, *CALSIM*  
3 *II Model Results utilized in the Fish Analysis*).

4 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
5 Existing Conditions during April through May, except in wet years during May (33% lower)  
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
8 flows under Existing Conditions during April except in above normal and below normal years (7%  
9 and 6% lower, respectively), but generally lower, by up to 29%, during May (Appendix 11C, *CALSIM*  
10 *II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects  
11 would be most critical for habitat conditions, consist of reductions in below normal years in both  
12 months (6% and 19% lower, respectively) and in critical years during May (15% lower, following a  
13 10% increase in flows during April), which are relatively small-magnitude flow reductions that  
14 would not have biologically meaningful negative effects.

15 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
16 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
17 reductions in flows during the period relative to Existing Conditions.

#### 18 *Water Temperature*

19 The percentage of months outside of the 59°F to 64°F suitable water temperature range for  
20 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,  
21 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced  
22 spawning success and increased egg and larval stress and mortality. Water temperatures were not  
23 modeled in the San Joaquin River or Clear Creek.

24 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
25 the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative  
26 1A.

27 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside of the  
28 59°F to 64°F water temperature range for hardhead spawning would be lower than the percentage  
29 under Existing Conditions in all water years except below normal years (18% higher) (Table 11-4-  
30 148).

#### 31 **H1/LOS**

32 Flows under H1 in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers  
33 and in Clear Creek during the April through May hardhead spawning period would generally be  
34 similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The  
35 percentage of months under H1 outside the 59°F to 64°F suitable water temperature range in the  
36 Feather River below Thermalito Afterbay would be similar to the percentage under H3 in all water  
37 year types (Table 11-4-149).

#### 38 **H4/HOS**

39 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through May period  
40 would generally be similar to flows under H3 (Appendix 11C, *CALSIM II Model Results utilized in the*

1 *Fish Analysis*). Flows under H4 in the Feather River at Thermalito Afterbay would up to 330%  
2 greater than flows under H3 during April and May. Flows under H4 in the Trinity, American, San  
3 Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 throughout the  
4 period. The percentage of months under H4 with mean water temperatures outside the 59°F to 64°F  
5 suitable water temperature range in the Feather River below Thermalito Afterbay would be similar  
6 to the percentage under H3 in all water years (Table 11-4-149).

7 Collectively, these results indicate that the effect would not be adverse because Alternative 4 would  
8 not cause a substantial reduction in roach spawning habitat, and no mitigation is necessary. Flows in  
9 most rivers examined during the April through May spawning period under Alternative 4 would  
10 generally be similar to or greater than flows under Existing Conditions. Flows in the San Joaquin and  
11 Stanislaus rivers would be lower under Alternative 4, although these reductions would not have  
12 population-level effects on hardhead. The percentage of years below the spawning temperature  
13 threshold under Alternative 4 would be similar to Existing Conditions and there are no differences  
14 in water temperatures between Existing Conditions and Alternative 4 in all other rivers and creeks  
15 examined.

### 16 ***California Bay Shrimp***

17 ***NEPA Effects:*** The effect of water operations on spawning habitat of California bay shrimp under  
18 Alternative 4 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
19 AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects  
20 would not be adverse.

21 ***CEQA Conclusion:*** The impact of water operations on spawning habitat of California bay shrimp  
22 would be the same as described immediately above. The impacts would be less than significant and  
23 no mitigation would be required.

### 24 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic 25 Species of Primary Management Concern**

26 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-  
27 covered species of primary management concern.

### 28 ***Striped Bass***

29 ***NEPA Effects:*** The discussion under Alternative 4, Impact AQUA-202 for striped bass also addressed  
30 the embryo incubation and initial rearing period. That analysis indicates that there is no adverse  
31 effect on striped bass rearing during that period. Other effects of water operations on rearing  
32 habitat for striped bass under Alternative 4 would be similar to that described for Alternative 1A  
33 (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact  
34 AQUA-203. The effects would not be adverse.

35 ***CEQA Conclusion:*** As described above the impacts on striped bass rearing habitat would be less  
36 than significant and no mitigation would be required.

### 37 ***American Shad***

38 The effects of water operations on rearing habitat for American shad under Alternative 4 would be  
39 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed  
40 discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

1 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less  
2 than significant and no mitigation would be required.

### 3 **Threadfin Shad**

4 **NEPA Effects:** The effects of water operations on rearing habitat for threadfin shad under  
5 Alternative 4 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
6 AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects  
7 would not be adverse.

8 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less  
9 than significant and no mitigation would be required.

### 10 **Largemouth Bass**

#### 11 **H3/ESO**

##### 12 *Juveniles*

##### 13 *Flows*

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
15 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
16 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
17 rearing.

18 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
19 greater than flows under NAA during April through October with some exceptions (to 14% lower),  
20 and would be lower in all water year types during November (to 18% lower) (Appendix 11C,  
21 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when  
22 effects on habitat conditions would be more critical, would be inconsistent and/or of small  
23 magnitude for all months during the rearing period and would not have biologically meaningful  
24 negative effects.

25 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to flows  
26 under NAA with isolated exceptions, including small flow reductions in critical years during August  
27 through October (to 11%) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA during  
29 April through November except in critical years during June (8% lower) (Appendix 11C, *CALSIM II*  
30 *Model Results utilized in the Fish Analysis*).

31 In the Feather River at Thermalito Afterbay, flows under H3 would generally be greater than flows  
32 under NAA during April through June, drier water years during September, in all water years during  
33 October, and in dry years during November; flows would be lower (to 50% lower) during July,  
34 August, wetter water years during September, and above normal years during November (Appendix  
35 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when  
36 effects would be more critical for habitat conditions, range from moderate to substantial in drier  
37 water years during July, August, and below normal years during September. These would be  
38 partially offset by increases in flow in the adjoining months (Appendix 11C, *CALSIM II Model Results*  
39 *utilized in the Fish Analysis*).

1 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
2 under NAA during April through July except in dry years during July (12% lower), and would be  
3 similar to or lower than flows under NAA (to 40% lower) during August through November with a  
4 few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions  
5 in drier water years when effects would be more critical for habitat conditions consist of small to  
6 moderate reductions for some months and water year types from July through November, which  
7 would be offset by increases in some months and/or not persistent within a single water year type.  
8 Effects would not be biologically meaningful.

9 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
10 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
11 between H3 and NAA.

12 *Water Temperature*

13 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
14 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
15 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
16 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
17 temperatures were not modeled in the San Joaquin River or Clear Creek.

18 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
19 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
20 be no temperature-related effects in these rivers during the April through November period.

21 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under  
22 NAA or H3. As a result, there would be no difference between NAA and H3 in the percentage of  
23 months in which the 88°F water temperature threshold is exceeded (Table 11-4-150).

24 **Table 11-4-150. Difference and Percent Difference in the Percentage of Months during April–**  
25 **November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed**  
26 **the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

27

1 *Adults*

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
4 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows  
5 could reduce the quantity and quality of instream habitat available for adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
7 greater than flows under NAA throughout the year with some exceptions (up to 14% lower), and  
8 would be lower in all water year types during November (up to 18% lower) (Appendix 11C, *CALSIM*  
9 *II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on  
10 habitat conditions would be more critical, would be inconsistent and/or of small magnitude for all  
11 months during the rearing period and, therefore, would not have biologically meaningful negative  
12 effects.

13 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to flows  
14 under NAA during the period with isolated exceptions (up to 11% lower), including small flow  
15 reductions in critical years during August through October (up to 12% lower) (Appendix 11C,  
16 *CALSIM II Model Results utilized in the Fish Analysis*).

17 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA  
18 throughout the year except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
19 *Results utilized in the Fish Analysis*).

20 In the Feather River at Thermalito Afterbay, flows under H3 would generally be similar to or greater  
21 than flows under NAA during January through June with a few isolated exceptions in drier water  
22 years during September, and during October through December with a few relatively isolated, small-  
23 magnitude reductions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
24 would be more persistently lower under H3 relative to NAA (up to 50% lower) during July, August,  
25 and in wetter water years during September (Appendix 11C, *CALSIM II Model Results utilized in the*  
26 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat  
27 conditions, range from moderate to substantial in drier water years during July, August, and below  
28 normal years during September. These would be partially offset by increases in flow in the adjoining  
29 months.

30 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
31 under NAA during January through July and December, with a few isolated, small-magnitude  
32 exceptions (up to 12% lower), and would be similar to or lower than flows under NAA (up to 40%  
33 lower) during August through November with a few exceptions (Appendix 11C, *CALSIM II Model*  
34 *Results utilized in the Fish Analysis*). Flow reductions in drier water years when effects would be  
35 more critical for habitat conditions consist of small to moderate reductions for some months and  
36 water year types from July through November, which would be offset by increases in some months  
37 and/or not persistent within a single water year type. Effects would not be biologically meaningful.

38 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
39 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
40 between H3 and NAA.

1 *Water Temperature*

2 The percentage of months above the 86°F water temperature threshold for year-round adult  
3 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
4 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
5 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
6 modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
8 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
9 be no temperature-related effects in these rivers during the year-round period.

10 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under  
11 NAA and H3 (Table 11-4-151). As a result, there would be no difference in the percentage of months  
12 in which the 86°F water temperature threshold is exceeded between NAA and H3.

13 **Table 11-4-151. Difference and Percent Difference in the Percentage of Months Year-Round in**  
14 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**  
15 **Water Temperature Threshold for Adult Largemouth Bass Survival<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

16

17 **H1/LOS**

18 *Juveniles*

19 Flows under H1 in the Sacramento River upstream of Red Bluff during the April through November  
20 juvenile largemouth bass rearing period would generally be similar to flows under H3 except in  
21 wetter water years during September, in which flows would be up to 45% lower (Appendix 11C,  
22 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 in the Trinity, San Joaquin, and  
23 Stanislaus rivers, and Clear Creek would generally be similar to flows under H3 throughout the  
24 period. Flows under H1 in the Feather River at Thermalito Afterbay would generally be similar to  
25 those under H3 except in wetter years during September, in which flows would be up to 83% lower.  
26 Flows under H1 in the American River below Nimbus Dam would generally be similar to those  
27 under H3 except in wetter years during September, in which flows would be up to 35% lower. Flow  
28 reductions in wetter water years are less critical to largemouth bass than in drier water years and,  
29 therefore, these flow reductions would not have biologically meaningful effects on largemouth bass  
30 rearing habitat.

1 Water temperatures in the Feather River below Thermalito Afterbay during the April through  
2 November juvenile largemouth bass rearing period would not exceed the 88°F water temperature  
3 threshold in H1 or H3. As a result, there would be no difference between H1 and H3 in the  
4 percentage of months in which the 88°F water temperature threshold is exceeded (Table 11-4-152).

5 **Table 11-4-152. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
6 **Model Scenarios in the Percentage of Months during April–November in Which Water**  
7 **Temperatures in the Feather River below Thermalito Afterbay Exceed the 88°F Water**  
8 **Temperature Threshold for Juvenile Largemouth Bass Rearing<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

9

10 *Adults*

11 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round adult  
12 largemouth bass rearing period would generally be similar to flows under H3 except in wetter water  
13 years during September and December, in which flows would be up to 45% lower (Appendix 11C,  
14 *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity, San  
15 Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few  
16 exceptions. Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater  
17 than flows under H3 during January and December, up to 83% lower during September, and  
18 generally similar during the remainder of months. Flows under H1 in the American River at Nimbus  
19 Dam would be up to 8% greater than flows under H3 during December, up to 35% lower during  
20 September, and generally similar during the remainder of months. Flow reductions would not be  
21 frequent enough to have biologically meaningful effects on adult largemouth bass rearing habitat.

22 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
23 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H1 or  
24 H3. As a result, there would be no difference between H1 and H3 in the percentage of months in  
25 which the 86°F water temperature threshold is exceeded (Table 11-4-153).

1 **Table 11-4-153. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months Year-Round in Which Water Temperatures in the**  
 3 **Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for Adult**  
 4 **Largemouth Bass Survival<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

5

6 **H4/HOS**

7 *Juveniles*

8 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through November  
 9 juvenile largemouth bass rearing period would generally be similar to flows under H3 except during  
 10 June, in which flows would be up to 12% lower, and during September, in which flows would be up  
 11 to 13% greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4  
 12 in the Trinity, San Joaquin, and Stanislaus rivers, and Clear Creek would generally be similar to flows  
 13 under H3 throughout the period. Flows under H4 in the Feather River at Thermalito Afterbay would  
 14 generally be up to 330% greater than flows under H3 during April and May, up to 39% lower during  
 15 June through October, and similar to flows under H3 during November. Based on these flow  
 16 reductions, adult rearing habitat conditions would generally be less favorable under H4 relative to  
 17 H3 in the Feather River. Flows under H4 in the American River below Nimbus Dam would generally  
 18 be up to 32% greater than flows under H3 during August and September, up to 20% lower during  
 19 June and October, and similar to flows under H3 during April, May, July, and November.

20 Water temperatures in the Feather River below Thermalito Afterbay during the April through  
 21 November juvenile largemouth bass rearing period would not exceed the 88°F water temperature  
 22 threshold in H4 or H3. As a result, there would be no difference between H4 and H3 in the  
 23 percentage of months in which the 88°F water temperature threshold is exceeded (Table 11-4-152).

24 *Adults*

25 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round adult  
 26 largemouth bass rearing period would generally be similar to flows under H3 except during June, in  
 27 which flows would be up to 12% lower, and during September, in which flows would be up to 13%  
 28 greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under  
 29 H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows  
 30 under H3 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay would  
 31 generally be up to 330% greater than flows under H3 during January, April, and May, up to 39%  
 32 lower during June through October, and similar to flows under H3 during February, March,  
 33 November, and December. Based on these flow reductions, adult rearing habitat conditions would

1 generally be less favorable under H4 relative to H3 in the Feather River. Flows under H4 in the  
2 American River below Nimbus Dam would generally be up to 32% greater than flows under H3  
3 during August and September, up to 20% lower during June and October, and similar to flows under  
4 H3 during the remaining eight months.

5 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
6 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H4 or  
7 H3. As a result, there would be no difference between H4 and H3 in the percentage of months in  
8 which the 86°F water temperature threshold is exceeded (Table 11-4-153).

9 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
10 Alternative 4 would not cause a substantial reduction in juvenile and adult rearing or spawning  
11 habitat. Flows in all rivers examined during the year under Alternative 4 are generally similar to or  
12 greater than flows under the NAA in most months. Flows in July or August through November are  
13 more likely to be lower for some water year types in some of the locations analyzed, however they  
14 are generally of small magnitude, not consistent from month to month within a specific water year  
15 type, and/or would be offset by increases in flow in the adjoining months. Therefore, the flow  
16 reductions are not expected to have biologically meaningful negative effects on the largemouth bass  
17 population. Flow-related habitat conditions in the Feather River for both juvenile and adult  
18 largemouth bass under H4 would be less favorable than those under H3 if water operations were to  
19 shift to this end of the adaptive limits. The percentage of months outside all temperature thresholds  
20 examined in the Feather River under Alternative 4 are the same as those under the NAA. Also, there  
21 are no temperature-related effects in any other rivers examined.

22 **CEQA Conclusion:** In general, Alternative 4 would reduce the quality and quantity of upstream  
23 habitat conditions for largemouth bass relative to Existing Conditions.

#### 24 *Juveniles*

##### 25 *Flows*

26 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
27 Clear Creek were examined during the April through November juvenile largemouth bass rearing  
28 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile  
29 rearing.

30 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
31 greater than flows under Existing Conditions during April through July and October, except in wet  
32 years during May (17% lower) and in critical years during July (9% lower) (Appendix 11C, *CALSIM*  
33 *II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or lower than flows  
34 under Existing Conditions during August, September, and November (to 26% lower) (Appendix 11C,  
35 *CALSIM II Model Results utilized in the Fish Analysis*). There would be primarily small flow reductions  
36 in some drier water year types for some months, but not persistent enough and of a magnitude that  
37 would not be expected to have biologically meaningful negative effects.

38 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
39 greater than flows under Existing Conditions during April through November, except in critical  
40 years during May (6% lower), in wet years during July (14% lower), in critical years during August  
41 through November (to 45% lower), and in most of the remaining water year types during October  
42 and November (to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
43 The persistent, small to moderate flow reductions in critical years during August through November

1 would have a localized effect on rearing conditions in that water year type. Flow reductions in the  
2 other drier water year types are inconsistent and of small magnitude and would not have  
3 biologically meaningful negative effects.

4 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
5 Existing Conditions during April through November regardless of water year type except in critical  
6 years during August through October (6% to 28% lower) (Appendix 11C, *CALSIM II Model Results*  
7 *utilized in the Fish Analysis*). This flow reduction is a relatively small, isolated effect limited to a  
8 single water year type and would not be expected to have biologically meaningful negative effects.

9 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
10 Existing Conditions during April through June and October, with a few isolated exceptions (to 33%  
11 lower), and in wetter water year types during July, August, and September (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be moderately to  
13 substantially lower than flows under Existing Conditions in drier water years during July through  
14 September (to 61% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
15 However, these would be offset by substantial increases in flow that would occur in drier water year  
16 types during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
17 and therefore are not expected to have biologically meaningful negative effects.

18 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
19 flows under Existing Conditions during April and June, except in above normal and below normal  
20 years during April (7% and 6% lower, respectively) and wet and critical years during June (27% and  
21 33% lower, respectively), but generally lower, by up to 48%, during May and July through  
22 November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be  
23 moderate flow reductions in drier water year types, when effects would be most critical for habitat  
24 conditions, for some months/water year types from May through November that would affect  
25 rearing conditions at this location (to 42% lower in below normal, to 48% lower in dry and to 43%  
26 lower in critical water years).

27 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
28 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
29 reductions in flows during the period relative to Existing Conditions.

### 30 *Water Temperature*

31 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass  
32 rearing during April through November was examined in the Sacramento, Trinity, Feather,  
33 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and  
34 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water  
35 temperatures were not modeled in the San Joaquin River or Clear Creek.

36 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
37 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
38 be no temperature-related effects in these rivers during the April through November period.

39 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F  
40 water temperature threshold for year-round juvenile largemouth bass occurrence under Existing  
41 Conditions or H3 (Table 11-4-150). As a result, there would be no difference in the percentage of  
42 months in which the 88°F water temperature threshold is exceeded between H3 and Existing  
43 Conditions.

1 *Adults*

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
4 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower  
5 flows could reduce the quantity and quality of instream habitat available for adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
7 greater than flows under Existing Conditions during January through July, October, and December,  
8 except in below normal years during March (10% lower), in wet years during May (17% lower), in  
9 critical years during July (9% lower), and in wet years during December (7% lower) (Appendix 11C,  
10 *CALSIM II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or lower  
11 than flows under Existing Conditions during August, September, and November (to 26% lower)  
12 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be primarily small  
13 flow reductions in some drier water year types for some months, but not persistent enough and of a  
14 magnitude that would not be expected to have biologically meaningful negative effects.

15 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
16 greater than flows under Existing Conditions throughout the year, except in below normal and  
17 critical years during January (16% and 8% lower, respectively), in below normal years during March  
18 (6% lower), in critical years during May (6% lower), in wet years during July (14% lower), in critical  
19 years during August through December (to 45% lower), and in most of the remaining water year  
20 types during October and November (to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized*  
21 *in the Fish Analysis*). The persistent, small to moderate flow reductions in critical years during  
22 August through December would have a localized effect on rearing conditions in that water year  
23 type. Flow reductions in the other drier water year types are inconsistent and of small magnitude  
24 and would not have biologically meaningful negative effects.

25 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
26 Existing Conditions throughout the year regardless of water year type except in critical years during  
27 August through October (6% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
28 *Fish Analysis*). This flow reduction is a relatively small, isolated effect limited to a single water year  
29 type and would not be expected to have biologically meaningful negative effects.

30 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
31 Existing Conditions during March through June and October, with a few isolated exceptions (to 53%  
32 lower), and in wetter water year types during July, August, and September (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be moderately to  
34 substantially lower than flows under Existing Conditions in drier water years during July through  
35 September (to 61% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
36 However, these would be offset by substantial increases in flow that would occur in drier water year  
37 types during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
38 and therefore are not expected to have biologically meaningful negative effects.

39 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
40 flows under Existing Conditions in wetter years during January, and most water years during  
41 February through April, with isolated exceptions of relatively small flow reductions (to 13% lower),  
42 but generally lower, by up to 48%, in drier years during January, most water years during May, wet  
43 and critical years during June, and in most water years during July through December (Appendix

1 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to substantial flow  
2 reductions in drier water year types, when effects would be most critical for habitat conditions, for  
3 some months/water year types during each month of the year, with the most consistent flow  
4 reductions in critical water years and the greatest magnitude of flow reductions occurring during  
5 June through December. These persistent flow reductions would affect rearing conditions at this  
6 location (to 42% lower in below normal, to 48% lower in dry and to 43% lower in critical water  
7 years).

8 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
9 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
10 reductions in flows during the period relative to Existing Conditions.

### 11 *Water Temperature*

12 The percentage of months above the 86°F water temperature threshold for year-round adult  
13 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and  
14 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult  
15 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not  
16 modeled in the San Joaquin River or Clear Creek.

17 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
18 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
19 be no temperature-related effects in these rivers during the April through November period.

20 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F  
21 water temperature range for year-round adult largemouth bass occurrence under Existing  
22 Conditions or H3 (Table 11-4-151). As a result, there would be no difference in the percentage of  
23 months in which the 86°F water temperature threshold is exceeded between H3 and Existing  
24 Conditions.

### 25 **H1/LOS**

#### 26 *Juveniles*

27 Flows under H1 in the Sacramento River upstream of Red Bluff during the April through November  
28 juvenile largemouth bass rearing period would generally be similar to flows under H3 except in  
29 wetter water years during September, in which flows would be up to 45% lower (Appendix 11C,  
30 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H1 in the Trinity, San Joaquin, and  
31 Stanislaus rivers, and Clear Creek would generally be similar to flows under H3 throughout the  
32 period. Flows under H1 in the Feather River at Thermalito Afterbay would generally be similar to  
33 those under H3 except in wetter years during September, in which flows would be up to 83% lower.  
34 Flows under H1 in the American River below Nimbus Dam would generally be similar to those  
35 under H3 except in wetter years during September, in which flows would be up to 35% lower. Flow  
36 reductions in wetter water years are less critical to largemouth bass than in drier water years and,  
37 therefore, these flow reductions would not have biologically meaningful effects on largemouth bass  
38 rearing habitat.

39 Water temperatures in the Feather River below Thermalito Afterbay during the April through  
40 November juvenile largemouth bass rearing period would not exceed the 88°F water temperature  
41 threshold in H1 or H3. As a result, there would be no difference between H1 and H3 in the  
42 percentage of months in which the 88°F water temperature threshold is exceeded (Table 11-4-152).

1 **Adults**

2 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round adult  
3 largemouth bass rearing period would generally be similar to flows under H3 except in wetter water  
4 years during September and December, in which flows would be up to 45% lower (Appendix 11C,  
5 *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity, San  
6 Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few  
7 exceptions. Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater  
8 than flows under H3 during January and December, up to 83% lower during September, and  
9 generally similar during the remainder of months. Flows under H1 in the American River at Nimbus  
10 Dam would be up to 8% greater than flows under H3 during December, up to 35% lower during  
11 September, and generally similar during the remainder of months. Flow reductions would not be  
12 frequent enough to have biologically meaningful effects on adult largemouth bass rearing habitat.

13 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
14 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H1 or  
15 H3. As a result, there would be no difference between H1 and H3 in the percentage of months in  
16 which the 86°F water temperature threshold is exceeded (Table 11-4-153).

17 **H4/HOS**

18 **Juveniles**

19 Flows under H4 in the Sacramento River upstream of Red Bluff during the April through November  
20 juvenile largemouth bass rearing period would generally be similar to flows under H3 except during  
21 June, in which flows would be up to 12% lower, and during September, in which flows would be up  
22 to 13% greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4  
23 in the Trinity, San Joaquin, and Stanislaus rivers, and Clear Creek would generally be similar to flows  
24 under H3 throughout the period. Flows under H4 in the Feather River at Thermalito Afterbay would  
25 generally be up to 330% greater than flows under H3 during April and May, up to 39% lower during  
26 June through October, and similar to flows under H3 during November. Based on these flow  
27 reductions, adult rearing habitat conditions would generally be less favorable under H4 relative to  
28 H3 in the Feather River. Flows under H4 in the American River below Nimbus Dam would generally  
29 be up to 32% greater than flows under H3 during August and September, up to 20% lower during  
30 June and October, and similar to flows under H3 during April, May, July, and November.

31 Water temperatures in the Feather River below Thermalito Afterbay during the April through  
32 November juvenile largemouth bass rearing period would not exceed the 88°F water temperature  
33 threshold in H4 or H3. As a result, there would be no difference between H4 and H3 in the  
34 percentage of months in which the 88°F water temperature threshold is exceeded (Table 11-4-152).

35 **Adults**

36 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round adult  
37 largemouth bass rearing period would generally be similar to flows under H3 except during June, in  
38 which flows would be up to 12% lower, and during September, in which flows would be up to 13%  
39 greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under  
40 H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows  
41 under H3 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay would  
42 generally be up to 330% greater than flows under H3 during January, April, and May, up to 39%

1 lower during June through October, and similar to flows under H3 during February, March,  
2 November, and December. Based on these flow reductions, adult rearing habitat conditions would  
3 generally be less favorable under H4 relative to H3 in the Feather River. Flows under H4 in the  
4 American River below Nimbus Dam would generally be up to 32% greater than flows under H3  
5 during August and September, up to 20% lower during June and October, and similar to flows under  
6 H3 during the remaining eight months.

7 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
8 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H4 or  
9 H3. As a result, there would be no difference between H4 and H3 in the percentage of months in  
10 which the 86°F water temperature threshold is exceeded (Table 11-4-153).

11 Collectively, these results indicate that the impact is not significant because Alternative 4 would not  
12 cause a substantial reduction in largemouth bass habitat and no mitigation is necessary. Flows  
13 would be substantially lower during the majority of the year-round adult rearing period in the  
14 American River, but based on the fact that this persistent effect occurs at only one location, it would  
15 not be expected to have biologically meaningful negative effects on the largemouth bass population.  
16 Flow reductions would occur throughout roughly half of the rearing period in the Feather River, but  
17 would be partially offset by substantial increases in flow during the preceding months. There would  
18 also be small to moderate flow reductions in the Trinity River in critical water years for roughly half  
19 the year that would have a localized effect juvenile and adult rearing in that water year type.  
20 Reduced flows in other rivers including the San Joaquin and Stanislaus rivers would not have  
21 biologically meaningful effects on largemouth bass. Flow-related habitat conditions in the Feather  
22 River for both juvenile and adult largemouth bass under H4 would be less favorable than those  
23 under H3 if water operations were to shift to this end of the adaptive limits. The percentages of  
24 months outside all temperature thresholds under Alternative 4 are the same as those under Existing  
25 Conditions. Also, there are no temperature-related effects in any other rivers examined.

### 26 ***Sacramento Tule Perch***

27 In general, Alternative 4 would not affect the quality and quantity of upstream habitat conditions for  
28 Sacramento tule perch relative to the NAA.

### 29 *Flows*

30 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
31 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
32 reduce the quantity and quality of instream habitat available for rearing.

33 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
34 greater than flows under NAA throughout the year with some exceptions (up to 14% lower), and  
35 would be lower in all water year types during November (up to 18% lower) (Appendix 11C, *CALSIM*  
36 *II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on  
37 habitat conditions would be more critical, would be inconsistent and/or of small magnitude for all  
38 months during the rearing period and, therefore, would not have biologically meaningful negative  
39 effects.

40 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to flows  
41 under NAA during the period with isolated exceptions (up to 11% lower), including small flow

1 reductions in critical years during August through October (up to 12% lower) (Appendix 11C,  
2 *CALSIM II Model Results utilized in the Fish Analysis*).

3 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA  
4 throughout the year except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
5 *Results utilized in the Fish Analysis*).

6 In the Feather River at Thermalito Afterbay, flows under H3 would generally be similar to or greater  
7 than flows under NAA during January through June with a few isolated exceptions, in drier water  
8 years during September, and during October through December with a few relatively isolated, small-  
9 magnitude reductions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
10 would be more persistently lower under H3 relative to NAA (up to 50% lower) during July, August,  
11 and in wetter water years during September (Appendix 11C, *CALSIM II Model Results utilized in the*  
12 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat  
13 conditions, range from moderate to substantial in drier water years during July, August, and below  
14 normal years during September. These would be partially offset by increases in flow in the adjoining  
15 months.

16 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
17 under NAA during January through July and December, with a few isolated, small-magnitude  
18 exceptions (up to 12% lower), and would be similar to or lower than flows under NAA (up to 40%  
19 lower) during August through November with a few exceptions (Appendix 11C, *CALSIM II Model*  
20 *Results utilized in the Fish Analysis*). Flow reductions in drier water years when effects would be  
21 more critical for habitat conditions consist of small to moderate reductions for some months and  
22 water year types from July through November, which would be offset by increases in some months  
23 and/or not persistent within a single water year type. Effects would not be biologically meaningful.

24 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
25 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
26 between H3 and NAA.

### 27 *Water Temperature*

28 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-  
29 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,  
30 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds  
31 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water  
32 temperatures were not modeled in the San Joaquin River or Clear Creek.

33 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
34 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
35 be no temperature-related effects in these rivers throughout the year.

36 In the Feather River below Thermalito Afterbay, the percentage of years under H3 exceeding the  
37 72°F threshold would be higher than the percentage under NAA by 16% to 65% depending on water  
38 year type (Table 11-4-154). Although relative differences in above normal, below normal, and  
39 critical years are large due to small values, the absolute differenced in percent exceedance are only  
40 2% to 6%, and do not represent biologically meaningful effects to Sacramento tule perch.

41 The percentage of months under H3 exceeding the 75°F threshold would be similar to or slightly  
42 greater than the percentage under NAA (up to 9% greater) (Table 11-4-154). The maximum

1 increase corresponds to an absolute increase of 1%, which would not represent a biologically  
2 meaningful effect to Sacramento tule perch.

3 **Table 11-4-154. Difference and Percent Difference in the Percentage of Months Year-Round in**  
4 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F**  
5 **Water Temperature Thresholds for Sacramento Tule Perch Occurrence<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
<b>72°F Threshold</b>		
Wet	3 (145%)	4 (184%)
Above Normal	2 (NA)	2 (188%)
Below Normal	7 (NA)	4 (137%)
Dry	11 (NA)	6 (118%)
Critical	13 (314%)	3 (19%)
All	7 (538%)	4 (84%)
<b>75°F Threshold</b>		
Wet	0.3 (NA)	0.3 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	1 (NA)	0 (0%)
Critical	6 (986%)	1 (10%)
All	1 (1,300%)	0.2 (17%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

6

7 **H1/LOS**

8 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round adult  
9 Sacramento tule perch rearing period would generally be similar to flows under H3 except in wetter  
10 water years during September and December, in which flows would be up to 45% lower (Appendix  
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity,  
12 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few  
13 exceptions. Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater  
14 than flows under H3 during January and December, up to 83% lower during September, and  
15 generally similar during the remainder of months. Flows under H1 in the American River at Nimbus  
16 Dam would be up to 8% greater than flows under H3 during December, up to 35% lower during  
17 September, and generally similar during the remainder of months. Flow reductions would not be  
18 frequent enough to have biologically meaningful effects on Sacramento tule perch upstream rearing  
19 habitat.

20 The percentage of months under H1 exceeding the 72°F and 75°F water temperature thresholds in  
21 the Feather River below Thermalito Afterbay during the year-round Sacramento tule perch rearing  
22 period would be similar to the percentage under H3 in all water year types (Table 11-4-155).

1 **Table 11-4-155. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months Year-Round in Which Water Temperatures in the**  
 3 **Feather River below Thermalito Afterbay Exceed 72°F and 75°F Water Temperature Thresholds for**  
 4 **Sacramento Tule Perch Occurrence<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
<b>72°F Threshold</b>		
Wet	0 (0%)	3 (54%)
Above Normal	0 (0%)	6 (261%)
Below Normal	-1 (-8%)	2 (25%)
Dry	-1 (-8%)	0 (0%)
Critical	-1 (-8%)	0 (0%)
All	-1 (-6%)	2 (25%)
<b>75°F Threshold</b>		
Wet	0 (0%)	1 (433%)
Above Normal	0 (NA)	1 (NA)
Below Normal	0 (NA)	3 (NA)
Dry	0 (0%)	1 (156%)
Critical	0 (0%)	0 (0%)
All	0 (0%)	1 (100%)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range under H1 or H4.

5

6 **H4/HOS**

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round Sacramento  
 8 tule perch rearing period would generally be similar to flows under H3 except during June, in which  
 9 flows would be up to 12% lower, and during September, in which flows would be up to 13% greater  
 10 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H4 in  
 11 the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3  
 12 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay would generally be  
 13 up to 330% greater than flows under H3 during January, April, and May, up to 39% lower during  
 14 June through October, and similar to flows under H3 during February, March, November, and  
 15 December. Based on these flow reductions, rearing habitat conditions would generally be less  
 16 favorable under H4 relative to H3 in the Feather River. Flows under H4 in the American River below  
 17 Nimbus Dam would generally be up to 32% greater than flows under H3 during August and  
 18 September, up to 20% lower during June and October, and similar to flows under H3 during the  
 19 remaining eight months.

20 The percentage of months under H4 exceeding the 72°F and 75°F water temperature thresholds in  
 21 the Feather River below Thermalito Afterbay during the year-round Sacramento tule perch rearing  
 22 period would generally be similar to the percentage under H3, except in above normal water years  
 23 under the 72°F threshold (6% higher)(Table 11-4-155).

24 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 25 Alternative 4 would not cause a substantial reduction in Sacramento tule perch habitat. Flows in all  
 26 rivers examined during the year under Alternative 4 are generally similar to or greater than flows

1 under the NAA in most months. Flows in July or August through November are more likely to be  
2 lower for some water year types in some of the locations analyzed, however they are generally of  
3 small magnitude, not consistent from month to month within a specific water year type, and/or  
4 would be offset by increases in flow in the adjoining months. Therefore, the flow reductions are not  
5 expected to have biologically meaningful negative effects on the Sacramento tule perch population.  
6 The percentages of months outside all temperature thresholds under Alternative 4 are generally  
7 similar to or only slightly greater than the percentages under the NAA.

8 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
9 habitat conditions for Sacramento tule perch relative to Existing Conditions.

#### 10 *Flows*

11 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
12 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could  
13 reduce the quantity and quality of instream habitat available for rearing.

14 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
15 greater than flows under Existing Conditions during January through July, October, and December,  
16 except in below normal years during March (10% lower), in wet years during May (17% lower), in  
17 critical years during July (9% lower), and in wet years during December (7% lower) (Appendix 11C,  
18 *CALSIM II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or lower  
19 than flows under Existing Conditions during August, September, and November (to 26% lower)  
20 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be primarily small  
21 flow reductions in some drier water year types for some months, but not persistent enough and of a  
22 magnitude that would not be expected to have biologically meaningful negative effects.

23 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
24 greater than flows under Existing Conditions throughout the year, except in below normal and  
25 critical years during January (16% and 8% lower, respectively), in below normal years during March  
26 (6% lower), in critical years during May (6% lower), in wet years during July (14% lower), in critical  
27 years during August through December (to 45% lower), and in most of the remaining water year  
28 types during October and November (to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized*  
29 *in the Fish Analysis*). The persistent, small to moderate flow reductions in critical years during  
30 August through December would have a localized effect on rearing conditions in that water year  
31 type. Flow reductions in the other drier water year types are inconsistent and of small magnitude  
32 and would not have biologically meaningful negative effects.

33 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
34 Existing Conditions throughout the year regardless of water year type except in critical years during  
35 August through October (6% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
36 *Fish Analysis*). This flow reduction is a relatively small, isolated effect limited to a single water year  
37 type and would not be expected to have biologically meaningful negative effects.

38 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
39 Existing Conditions during March through June and October, with a few isolated exceptions (to 53%  
40 lower), and in wetter water year types during July, August, and September (Appendix 11C, *CALSIM II*  
41 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be moderately to  
42 substantially lower than flows under Existing Conditions in drier water years during July through  
43 September (to 61% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 However, these would be offset by substantial increases in flow that would occur in drier water year  
2 types during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
3 and therefore are not expected to have biologically meaningful negative effects.

4 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
5 flows under Existing Conditions in wetter years during January, and most water years during  
6 February through April, with isolated exceptions of relatively small flow reductions (to 13% lower),  
7 but generally lower, by up to 48%, in drier years during January, most water years during May, wet  
8 and critical years during June, and in most water years during July through December (Appendix  
9 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to substantial flow  
10 reductions in drier water year types, when effects would be most critical for habitat conditions, for  
11 some months/water year types during each month of the year, with the most consistent flow  
12 reductions in critical water years and the greatest magnitude of flow reductions occurring during  
13 June through December. These persistent flow reductions would affect rearing conditions at this  
14 location (to 42% lower in below normal, to 48% lower in dry and to 43% lower in critical water  
15 years).

16 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
17 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
18 reductions in flows during the period relative to Existing Conditions.

#### 19 *Water Temperature*

20 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round  
21 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,  
22 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead  
23 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not  
24 modeled in Clear Creek or the San Joaquin River.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
26 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
27 be no temperature-related effects in these rivers during the year.

28 In the Feather River below Thermalito Afterbay, the percentage of months under H3 exceeding 72°F  
29 relative to the percentage under Existing Conditions would be similar to or higher, by up to 314%  
30 (Table 11-4-154). The increases correspond to relatively small absolute increases, up to 13%, and  
31 are not expected to have biologically meaningful negative effects.

32 The percentage of years under H3 exceeding 75°F would be similar to the percentage under Existing  
33 Conditions in all water years except critical years (986% higher) (Table 11-4-154). The increase  
34 corresponds to a small absolute increase (6%) and would not have biologically meaningful negative  
35 effects.

#### 36 **H1/LOS**

37 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round adult  
38 Sacramento tule perch rearing period would generally be similar to flows under H3 except in wetter  
39 water years during September and December, in which flows would be up to 45% lower (Appendix  
40 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity,  
41 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few  
42 exceptions. Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater

1 than flows under H3 during January and December, up to 83% lower during September, and  
2 generally similar during the remainder of months. Flows under H1 in the American River at Nimbus  
3 Dam would be up to 8% greater than flows under H3 during December, up to 35% lower during  
4 September, and generally similar during the remainder of months. Flow reductions would not be  
5 frequent enough to have biologically meaningful effects on Sacramento tule perch upstream rearing  
6 habitat.

7 The percentage of months under H1 exceeding the 72°F and 75°F water temperature thresholds in  
8 the Feather River below Thermalito Afterbay during the year-round Sacramento tule perch rearing  
9 period would be similar to the percentage under H3 in all water year types (Table 11-4-155).

#### 10 **H4/HOS**

11 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round Sacramento  
12 tule perch rearing period would generally be similar to flows under H3 except during June, in which  
13 flows would be up to 12% lower, and during September, in which flows would be up to 13% greater  
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H4 in  
15 the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3  
16 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay would generally be  
17 up to 330% greater than flows under H3 during January, April, and May, up to 39% lower during  
18 June through October, and similar to flows under H3 during February, March, November, and  
19 December. Based on these flow reductions, rearing habitat conditions would generally be less  
20 favorable under H4 relative to H3 in the Feather River. Flows under H4 in the American River below  
21 Nimbus Dam would generally be up to 32% greater than flows under H3 during August and  
22 September, up to 20% lower during June and October, and similar to flows under H3 during the  
23 remaining eight months.

24 The percentage of months under H4 exceeding the 72°F and 75°F water temperature thresholds in  
25 the Feather River below Thermalito Afterbay during the year-round Sacramento tule perch rearing  
26 period would generally be similar to the percentage under H3, except in above normal water years  
27 under the 72°F threshold (6% higher)(Table 11-4-155).

28 Collectively, these results indicate that the impact is not significant because Alternative 4 would not  
29 cause a substantial reduction in Sacramento tule perch habitat, and no mitigation is necessary.  
30 Flows would be substantially lower during the majority of the year-round adult rearing period in the  
31 American River, but based on the fact that this persistent effect occurs at only one location, it would  
32 not be expected to have biologically meaningful negative effects on the Sacramento tule perch  
33 population. Flow reductions would occur throughout roughly half of the rearing period in the  
34 Feather River, but would be partially offset by substantial increases in flow during the preceding  
35 months. There would also be small to moderate flow reductions in the Trinity River in critical water  
36 years for roughly half the year that would have a localized effect juvenile and adult rearing in that  
37 water year type. Reduced flows in other rivers including the San Joaquin and Stanislaus rivers would  
38 not have biologically meaningful effects. The percentages of months outside both temperature  
39 thresholds are generally lower under Alternative 4 than under Existing Conditions.

#### 40 **Sacramento-San Joaquin Roach**

41 In general, Alternative 4 would not affect the quality and quantity of upstream habitat conditions for  
42 Sacramento-San Joaquin roach relative to the NAA.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
4 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
5 rearing.

6 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
7 greater than flows under NAA throughout the year with some exceptions (up to 14% lower), and  
8 would be lower in all water year types during November (up to 18% lower) (Appendix 11C, *CALSIM*  
9 *II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on  
10 habitat conditions would be more critical, would be inconsistent and/or of small magnitude for all  
11 months during the rearing period and, therefore, would not have biologically meaningful negative  
12 effects.

13 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to flows  
14 under NAA during the period with isolated exceptions (up to 11% lower), including small flow  
15 reductions in critical years during August through October (up to 12% lower) (Appendix 11C,  
16 *CALSIM II Model Results utilized in the Fish Analysis*).

17 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA  
18 throughout the year except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
19 *Results utilized in the Fish Analysis*).

20 In the Feather River at Thermalito Afterbay, flows under H3 would generally be similar to or greater  
21 than flows under NAA during January through June with a few isolated exceptions, in drier water  
22 years during September, and during October through December with a few relatively isolated, small-  
23 magnitude reductions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
24 would be more persistently lower under H3 relative to NAA (up to 50% lower) during July, August,  
25 and in wetter water years during September (Appendix 11C, *CALSIM II Model Results utilized in the*  
26 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat  
27 conditions, range from moderate to substantial in drier water years during July, August, and below  
28 normal years during September. These would be partially offset by increases in flow in the adjoining  
29 months.

30 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
31 under NAA during January through July and December, with a few isolated, small-magnitude  
32 exceptions (up to 12% lower), and would be similar to or lower than flows under NAA (up to 40%  
33 lower) during August through November with a few exceptions (Appendix 11C, *CALSIM II Model*  
34 *Results utilized in the Fish Analysis*). Flow reductions in drier water years when effects would be  
35 more critical for habitat conditions consist of small to moderate reductions for some months and  
36 water year types from July through November, which would be offset by increases in some months  
37 and/or not persistent within a single water year type. Effects would not be biologically meaningful.

38 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
39 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
40 between H3 and NAA.

1 *Water Temperature*

2 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
3 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
4 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing  
5 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San  
6 Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
8 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
9 be no temperature-related effects in these rivers throughout the year.

10 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under  
11 NAA or H3 (Table 11-4-156). As a result, there would be no difference in the percentage of months in  
12 which the 86°F water temperature threshold is exceeded between NAA and H3.

13 **Table 11-4-156. Difference and Percent Difference in the Percentage of Months Year-Round in**  
14 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**  
15 **Water Temperature Threshold for Sacramento-San Joaquin Roach Survival<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

16

17 **H1/LOS**

18 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round Sacramento-  
19 San Joaquin roach rearing period would generally be similar to flows under H3 except in wetter  
20 water years during September and December, in which flows would be up to 45% lower (Appendix  
21 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity,  
22 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few  
23 exceptions. Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater  
24 than flows under H3 during January and December, up to 83% lower during September, and  
25 generally similar during the remainder of months. Flows under H1 in the American River at Nimbus  
26 Dam would be up to 8% greater than flows under H3 during December, up to 35% lower during  
27 September, and generally similar during the remainder of months. Flow reductions would not be  
28 frequent enough to have biologically meaningful effects on roach upstream rearing habitat.

29 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
30 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H1 or  
31 H3. As a result, there would be no difference between H1 and H3 in the percentage of months in  
32 which the 86°F water temperature threshold is exceeded (Table 11-4-157).

1 **Table 11-4-157. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months Year-Round in Which Water Temperatures in the**  
 3 **Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for**  
 4 **Sacramento-San Joaquin Roach Survival<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

5

6 **H4/HOS**

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round Sacramento-  
 8 San Joaquin roach rearing period would generally be similar to flows under H3 except during June,  
 9 in which flows would be up to 12% lower, and during September, in which flows would be up to  
 10 13% greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows  
 11 under H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to  
 12 flows under H3 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay  
 13 would generally be up to 330% greater than flows under H3 during January, April, and May, up to  
 14 39% lower during June through October, and similar to flows under H3 during February, March,  
 15 November, and December. Based on these flow reductions, rearing habitat conditions would  
 16 generally be less favorable under H4 relative to H3 in the Feather River. Flows under H4 in the  
 17 American River below Nimbus Dam would generally be up to 32% greater than flows under H3  
 18 during August and September, up to 20% lower during June and October, and similar to flows under  
 19 H3 during the remaining eight months.

20 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
 21 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H4 or  
 22 H3. As a result, there would be no difference between H4 and H3 in the percentage of months in  
 23 which the 86°F water temperature threshold is exceeded (Table 11-4-157).

24 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 25 Alternative 4 would not cause a substantial reduction in spawning and juvenile and adult  
 26 Sacramento-San Joaquin roach rearing habitat. Flows in all rivers examined during the year under  
 27 Alternative 4 are generally similar to or greater than flows under the NAA in most months. Flows in  
 28 July or August through November are more likely to be lower for some water year types in some of  
 29 the locations analyzed, however they are generally of small magnitude, not consistent from month to  
 30 month within a specific water year type, and/or would be offset by increases in flow in the adjoining  
 31 months. Therefore, the flow reductions are not expected to have biologically meaningful negative  
 32 effects on the largemouth bass population. The percentage of months outside temperature  
 33 thresholds are generally similar to or lower under Alternative 4 than under the NAA.

1 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
2 habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

3 *Flows*

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
5 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach  
6 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for  
7 rearing.

8 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
9 greater than flows under Existing Conditions during January through July, October, and December,  
10 except in below normal years during March (10% lower), in wet years during May (17% lower), in  
11 critical years during July (9% lower), and in wet years during December (7% lower) (Appendix 11C,  
12 *CALSIM II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or lower  
13 than flows under Existing Conditions during August, September, and November (to 26% lower).  
14 There would be primarily small flow reductions in some drier water year types for some months,  
15 but not persistent enough and of a magnitude that would not be expected to have biologically  
16 meaningful negative effects.

17 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
18 greater than flows under Existing Conditions throughout the year, except in below normal and  
19 critical years during January (16% and 8% lower, respectively), in below normal years during March  
20 (6% lower), in critical years during May (6% lower), in wet years during July (14% lower), in critical  
21 years during August through December (to 45% lower), and in most of the remaining water year  
22 types during October and November (to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized*  
23 *in the Fish Analysis*). The persistent, small to moderate flow reductions in critical years during  
24 August through December would have a localized effect on rearing conditions in that water year  
25 type. Flow reductions in the other drier water year types are inconsistent and of small magnitude  
26 and would not have biologically meaningful negative effects.

27 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
28 Existing Conditions throughout the year regardless of water year type except in critical years during  
29 August through October (6% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
30 *Fish Analysis*). This flow reduction is a relatively small, isolated effect limited to a single water year  
31 type and would not be expected to have biologically meaningful negative effects.

32 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
33 Existing Conditions during March through June and October, with a few isolated exceptions (to 53%  
34 lower), and in wetter water year types during July, August, and September (Appendix 11C, *CALSIM II*  
35 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be moderately to  
36 substantially lower than flows under Existing Conditions in drier water years during July through  
37 September (to 61% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
38 However, these would be offset by substantial increases in flow that would occur in drier water year  
39 types during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
40 and therefore are not expected to have biologically meaningful negative effects.

41 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
42 flows under Existing Conditions in wetter years during January, and most water years during  
43 February through April, with isolated exceptions of relatively small flow reductions (to 13% lower),

1 but generally lower, by up to 48%, in drier years during January, most water years during May, wet  
2 and critical years during June, and in most water years during July through December (Appendix  
3 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to substantial flow  
4 reductions in drier water year types, when effects would be most critical for habitat conditions, for  
5 some months/water year types during each month of the year, with the most consistent flow  
6 reductions in critical water years and the greatest magnitude of flow reductions occurring during  
7 June through December. These persistent flow reductions would affect rearing conditions at this  
8 location (to 42% lower in below normal, to 48% lower in dry and to 43% lower in critical water  
9 years).

10 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
11 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
12 reductions in flows during the period relative to Existing Conditions.

### 13 *Water Temperature*

14 The percentage of months above the 86°F water temperature threshold for year-round juvenile and  
15 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,  
16 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced  
17 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.  
18 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

19 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
20 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
21 be no temperature-related effects in these rivers during the April through November period.

22 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water  
23 temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or  
24 H3 (Table 11-4-156). As a result, there would be no difference in the percentage of months in which  
25 the 86°F water temperature threshold is exceeded between H3 and Existing Conditions.

### 26 **H1/LOS**

27 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round Sacramento-  
28 San Joaquin roach rearing period would generally be similar to flows under H3 except in wetter  
29 water years during September and December, in which flows would be up to 45% lower (Appendix  
30 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity,  
31 San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few  
32 exceptions. Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater  
33 than flows under H3 during January and December, up to 83% lower during September, and  
34 generally similar during the remainder of months. Flows under H1 in the American River at Nimbus  
35 Dam would be up to 8% greater than flows under H3 during December, up to 35% lower during  
36 September, and generally similar during the remainder of months. Flow reductions would not be  
37 frequent enough to have biologically meaningful effects on roach upstream rearing habitat.

38 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
39 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H1 or  
40 H3. As a result, there would be no difference between H1 and H3 in the percentage of months in  
41 which the 86°F water temperature threshold is exceeded (Table 11-4-157).

1 **H4/HOS**

2 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round Sacramento-  
3 San Joaquin roach rearing period would generally be similar to flows under H3 except during June,  
4 in which flows would be up to 12% lower, and during September, in which flows would be up to  
5 13% greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows  
6 under H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to  
7 flows under H3 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay  
8 would generally be up to 330% greater than flows under H3 during January, April, and May, up to  
9 39% lower during June through October, and similar to flows under H3 during February, March,  
10 November, and December. Based on these flow reductions, rearing habitat conditions would  
11 generally be less favorable under H4 relative to H3 in the Feather River. Flows under H4 in the  
12 American River below Nimbus Dam would generally be up to 32% greater than flows under H3  
13 during August and September, up to 20% lower during June and October, and similar to flows under  
14 H3 during the remaining eight months.

15 Water temperatures in the Feather River below Thermalito Afterbay during the year-round adult  
16 largemouth bass rearing period would not exceed the 86°F water temperature threshold in H4 or  
17 H3. As a result, there would be no difference between H4 and H3 in the percentage of months in  
18 which the 86°F water temperature threshold is exceeded (Table 11-4-157).

19 Collectively, these results indicate that the impact would not be significant because Alternative 4  
20 would not cause a substantial reduction in Sacramento-San Joaquin roach habitat, and no mitigation  
21 is necessary. Flows would be substantially lower during the majority of the year-round adult rearing  
22 period in the American River, but based on the fact that this persistent effect occurs at only one  
23 location, it would not be expected to have biologically meaningful negative effects on the largemouth  
24 bass population. Flow reductions would occur throughout roughly half of the rearing period in the  
25 Feather River, but would be partially offset by substantial increases in flow during the preceding  
26 months. There would also be small to moderate flow reductions in the Trinity River in critical water  
27 years for roughly half the year that would have a localized effect juvenile and adult rearing in that  
28 water year type. Reduced flows in other rivers including the San Joaquin and Stanislaus rivers would  
29 not have biologically meaningful effects on largemouth bass. The percentages of months outside  
30 both temperature thresholds would generally be lower under Alternative 4 than under Existing  
31 Conditions.

32 **Hardhead**

33 In general, H4 would not affect the quality and quantity of upstream habitat conditions for hardhead  
34 relative to the NAA.

35 **Flows**

36 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
37 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
38 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
39 adult rearing.

40 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
41 greater than flows under NAA throughout the year with some exceptions (up to 14% lower), and  
42 would be lower in all water year types during November (up to 18% lower) (Appendix 11C, *CALSIM*  
43 *II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on

1 habitat conditions would be more critical, would be inconsistent and/or of small magnitude for all  
2 months during the rearing period and, therefore, would not have biologically meaningful negative  
3 effects.

4 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to flows  
5 under NAA during the period with isolated exceptions (up to 11% lower), including small flow  
6 reductions in critical years during August through October (up to 12% lower) (Appendix 11C,  
7 *CALSIM II Model Results utilized in the Fish Analysis*).

8 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to flows under NAA  
9 throughout the year except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*  
10 *Results utilized in the Fish Analysis*).

11 In the Feather River at Thermalito Afterbay, flows under H3 would generally be similar to or greater  
12 than flows under NAA during January through June with a few isolated exceptions, in drier water  
13 years during September, and during October through December with a few relatively isolated, small-  
14 magnitude reductions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows  
15 would be more persistently lower under H3 relative to NAA (up to 50% lower) during July, August,  
16 and in wetter water years during September (Appendix 11C, *CALSIM II Model Results utilized in the*  
17 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat  
18 conditions, range from moderate to substantial in drier water years during July, August, and below  
19 normal years during September. These would be partially offset by increases in flow in the adjoining  
20 months.

21 In the American River at Nimbus Dam, flows under H3 would be similar to or greater than flows  
22 under NAA during January through July and December, with a few isolated, small-magnitude  
23 exceptions (up to 12% lower), and would be similar to or lower than flows under NAA (up to 40%  
24 lower) during August through November with a few exceptions (Appendix 11C, *CALSIM II Model*  
25 *Results utilized in the Fish Analysis*). Flow reductions in drier water years when effects would be  
26 more critical for habitat conditions consist of small to moderate reductions for some months and  
27 water year types from July through November, which would be offset by increases in some months  
28 and/or not persistent within a single water year type. Effects would not be biologically meaningful.

29 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
30 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows  
31 between H3 and NAA.

### 32 *Water Temperature*

33 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for  
34 juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,  
35 and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat  
36 quality and increased stress and mortality. Water temperatures were not modeled in the San  
37 Joaquin River or Clear Creek.

38 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
39 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
40 be no temperature-related effects in these rivers throughout the year.

1 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside the  
2 range would be similar to or lower than the percentage under NAA in all water year except below  
3 normal years (5% higher) (Table 11-4-158).

4 **Table 11-4-158. Difference and Percent Difference in the Percentage of Months Year-Round in**  
5 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F**  
6 **to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence<sup>a</sup>**

Water Year Type	EXISTING CONDITIONS vs. H3	NAA vs. H3
Wet	-2 (-3%)	2 (3%)
Above Normal	-9 (-12%)	-4 (-6%)
Below Normal	-5 (-7%)	5 (8%)
Dry	-7 (-10%)	0 (0%)
Critical	-7 (-10%)	-1 (-2%)
All	-5 (-7%)	1 (2%)

<sup>a</sup> A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

7

8 **H1/LOS**

9 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round hardhead  
10 rearing period would generally be similar to flows under H3 except in wetter water years during  
11 September and December, in which flows would be up to 45% lower (Appendix 11C, *CALSIM II*  
12 *Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity, San Joaquin,  
13 and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few exceptions.  
14 Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater than flows  
15 under H3 during January and December, up to 83% lower during September, and generally similar  
16 during the remainder of months. Flows under H1 in the American River at Nimbus Dam would be up  
17 to 8% greater than flows under H3 during December, up to 35% lower during September, and  
18 generally similar during the remainder of months. Flow reductions would not be frequent enough to  
19 have biologically meaningful effects on hardhead upstream rearing habitat.

20 The percentage of months under H1 outside the 65°F to 82.4°F water temperature range in the  
21 Feather River below Thermalito Afterbay during the year-round hardhead rearing period would be  
22 similar to the percentage under H3 in all water year types (Table 11-4-159).

1 **Table 11-4-159. Difference and Percent Difference between the H3 Model Scenario and H1 and H4**  
 2 **Model Scenarios in the Percentage of Months Year-Round in Which Water Temperatures in the**  
 3 **Feather River below Thermalito Afterbay Are outside the 65°F to 82.4°F Water Temperature**  
 4 **Range for Juvenile and Adult Hardhead Occurrence<sup>a</sup>**

Water Year Type	H3 vs. H1	H3 vs. H4
Wet	-4 (-5%)	-4 (-5%)
Above Normal	2 (3%)	0 (0%)
Below Normal	-2 (-3%)	-1 (-2%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	1 (2%)
All	-1 (-1%)	-1 (-1%)

<sup>a</sup> A negative value indicates a reduction in percentage of months outside suitable range for H1 or H4.

5

6 **H4/HOS**

7 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round juvenile and  
 8 adult hardhead rearing period would generally be similar to flows under H3 except during June, in  
 9 which flows would be up to 12% lower, and during September, in which flows would be up to 13%  
 10 greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under  
 11 H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows  
 12 under H3 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay would  
 13 generally be up to 330% greater than flows under H3 during January, April, and May, up to 39%  
 14 lower during June through October, and similar to flows under H3 during February, March,  
 15 November, and December. Based on these flow reductions, rearing habitat conditions would  
 16 generally be less favorable under H4 relative to H3 in the Feather River. Flows under H4 in the  
 17 American River below Nimbus Dam would generally be up to 32% greater than flows under H3  
 18 during August and September, up to 20% lower during June and October, and similar to flows under  
 19 H3 during the remaining eight months.

20 The percentage of months under H4 outside the 65°F to 82.4°F water temperature range in the  
 21 Feather River below Thermalito Afterbay during the year-round hardhead rearing period would be  
 22 similar to the percentage under H3 in all water year types (Table 11-4-159).

23 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because  
 24 Alternative 4 would not cause a substantial reduction in spawning and juvenile and adult hardhead  
 25 rearing. Flows in all rivers examined during the year under Alternative 4 are generally similar to or  
 26 greater than flows under the NAA in most months. Flows in July or August through November are  
 27 more likely to be lower for some water year types in some of the locations analyzed, however they  
 28 are generally of small magnitude, not consistent from month to month within a specific water year  
 29 type, and/or would be offset by increases in flow in the adjoining months. Therefore, the flow  
 30 reductions are not expected to have biologically meaningful negative effects on hardhead. The  
 31 percentages of months outside all temperature thresholds are generally lower under Alternative 4  
 32 than under the NAA.

33 **CEQA Conclusion:** In general, Alternative 4 would not affect the quality and quantity of upstream  
 34 habitat conditions for hardhead relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in  
3 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.  
4 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and  
5 adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under H3 would generally be similar to or  
7 greater than flows under Existing Conditions during January through July, October, and December,  
8 except in below normal years during March (10% lower), in wet years during May (17% lower), in  
9 critical years during July (9% lower), and in wet years during December (7% lower) (Appendix 11C,  
10 *CALSIM II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or lower  
11 than flows under Existing Conditions during August, September, and November (to 26% lower).  
12 There would be primarily small flow reductions in some drier water year types for some months,  
13 but not persistent enough and of a magnitude that would not be expected to have biologically  
14 meaningful negative effects.

15 In the Trinity River below Lewiston Reservoir, flows under H3 would generally be similar to or  
16 greater than flows under Existing Conditions throughout the year, except in below normal and  
17 critical years during January (16% and 8% lower, respectively), in below normal years during March  
18 (6% lower), in critical years during May (6% lower), in wet years during July (14% lower), in critical  
19 years during August through December (to 45% lower), and in most of the remaining water year  
20 types during October and November (to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized*  
21 *in the Fish Analysis*). The persistent, small to moderate flow reductions in critical years during  
22 August through December would have a localized effect on rearing conditions in that water year  
23 type. Flow reductions in the other drier water year types are inconsistent and of small magnitude  
24 and would not have biologically meaningful negative effects.

25 In Clear Creek at Whiskeytown Dam, flows under H3 would be similar to or greater than flows under  
26 Existing Conditions throughout the year regardless of water year type except in critical years during  
27 August through October (6% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*  
28 *Fish Analysis*). This flow reduction is a relatively small, isolated effect limited to a single water year  
29 type and would not be expected to have biologically meaningful negative effects.

30 In the Feather River at Thermalito Afterbay, flows under H3 would be greater than flows under  
31 Existing Conditions during March through June and October, with a few isolated exceptions (to 53%  
32 lower), and in wetter water year types during July, August, and September (Appendix 11C, *CALSIM II*  
33 *Model Results utilized in the Fish Analysis*). Flows under H3 would generally be moderately to  
34 substantially lower than flows under Existing Conditions in drier water years during July through  
35 September (to 61% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).  
36 However, these would be offset by substantial increases in flow that would occur in drier water year  
37 types during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)  
38 and therefore are not expected to have biologically meaningful negative effects.

39 In the American River at Nimbus Dam, flows under H3 would generally be similar to or greater than  
40 flows under Existing Conditions in wetter years during January, and most water years during  
41 February through April, with isolated exceptions of relatively small flow reductions (to 13% lower),  
42 but generally lower, by up to 48%, in drier years during January, most water years during May, wet  
43 and critical years during June, and in most water years during July through December (Appendix  
44 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to substantial flow

1 reductions in drier water year types, when effects would be most critical for habitat conditions, for  
2 some months/water year types during each month of the year, with the most consistent flow  
3 reductions in critical water years and the greatest magnitude of flow reductions occurring during  
4 June through December. These persistent flow reductions would affect rearing conditions at this  
5 location (to 42% lower in below normal, to 48% lower in dry and to 43% lower in critical water  
6 years).

7 Flow rates in the San Joaquin and Stanislaus rivers under H3 would be the same as those under  
8 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate  
9 reductions in flows during the period relative to Existing Conditions.

#### 10 *Water Temperature*

11 The percentage of months in which year-round in-stream temperatures would be outside of the  
12 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was  
13 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures  
14 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.  
15 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under H3 would be  
17 the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would  
18 be no temperature-related effects in these rivers during the April through November period.

19 In the Feather River below Thermalito Afterbay, the percentage of months under H3 outside of the  
20 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be  
21 similar to or lower than the percentage under Existing Conditions in all water years (Table 11-4-  
22 158).

#### 23 **H1/LOS**

24 Flows under H1 in the Sacramento River upstream of Red Bluff during the year-round hardhead  
25 rearing period would generally be similar to flows under H3 except in wetter water years during  
26 September and December, in which flows would be up to 45% lower (Appendix 11C, *CALSIM II*  
27 *Model Results utilized in the Fish Analysis*). Year-round flows under H1 in the Trinity, San Joaquin,  
28 and Stanislaus rivers and in Clear Creek would be similar to flows under H3 with few exceptions.  
29 Flows under H1 in the Feather River at Thermalito Afterbay would be up to 29% greater than flows  
30 under H3 during January and December, up to 83% lower during September, and generally similar  
31 during the remainder of months. Flows under H1 in the American River at Nimbus Dam would be up  
32 to 8% greater than flows under H3 during December, up to 35% lower during September, and  
33 generally similar during the remainder of months. Flow reductions would not be frequent enough to  
34 have biologically meaningful effects on hardhead upstream rearing habitat.

35 The percentage of months under H1 outside the 65°F to 82.4°F water temperature range in the  
36 Feather River below Thermalito Afterbay during the year-round hardhead rearing period would be  
37 similar to the percentage under H3 in all water year types (Table 11-4-159).

#### 38 **H4/HOS**

39 Flows under H4 in the Sacramento River upstream of Red Bluff during the year-round juvenile and  
40 adult hardhead rearing period would generally be similar to flows under H3 except during June, in  
41 which flows would be up to 12% lower, and during September, in which flows would be up to 13%

1 greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Year-round flows under  
2 H4 in the Trinity, San Joaquin, and Stanislaus rivers and in Clear Creek would be similar to flows  
3 under H3 with few exceptions. Flows under H4 in the Feather River at Thermalito Afterbay would  
4 generally be up to 330% greater than flows under H3 during January, April, and May, up to 39%  
5 lower during June through October, and similar to flows under H3 during February, March,  
6 November, and December. Based on these flow reductions, rearing habitat conditions would  
7 generally be less favorable under H4 relative to H3 in the Feather River. Flows under H4 in the  
8 American River below Nimbus Dam would generally be up to 32% greater than flows under H3  
9 during August and September, up to 20% lower during June and October, and similar to flows under  
10 H3 during the remaining eight months.

11 The percentage of months under H4 outside the 65°F to 82.4°F water temperature range in the  
12 Feather River below Thermalito Afterbay during the year-round hardhead rearing period would be  
13 similar to the percentage under H3 in all water year types (Table 11-4-159).

14 Collectively, these results indicate that the impact is not significant because Alternative 4 would not  
15 cause a substantial reduction in hardhead habitat, and no mitigation is necessary. Flows would be  
16 substantially lower during the majority of the year-round adult rearing period in the American  
17 River, but based on the fact that this persistent effect occurs at only one location, it would not be  
18 expected to have biologically meaningful negative effects on the largemouth bass population. Flow  
19 reductions would occur throughout roughly half of the rearing period in the Feather River, but  
20 would be partially offset by substantial increases in flow during the preceding months. There would  
21 also be small to moderate flow reductions in the Trinity River in critical water years for roughly half  
22 the year that would have a localized effect juvenile and adult rearing in that water year type.  
23 Reduced flows in other rivers including the San Joaquin and Stanislaus rivers would not have  
24 biologically meaningful effects on hardhead. The percentages of months outside both temperature  
25 thresholds are generally lower under Alternative 4 than under Existing Conditions.

#### 26 ***California Bay Shrimp***

27 ***NEPA Effects:*** The effect of water operations on rearing habitat of California bay shrimp under  
28 Alternative 4 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
29 AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. These effects  
30 would not be adverse.

31 ***CEQA Conclusion:*** As described above the impacts on California bay shrimp rearing habitat would  
32 be less than significant and no mitigation would be required.

#### 33 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered** 34 **Aquatic Species of Primary Management Concern**

35 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-  
36 covered species of primary management concern.

#### 37 ***Striped Bass***

38 ***NEPA Effects:*** Under Alternative 4 Scenario H3, average monthly flows in the Sacramento River  
39 downstream of the north Delta intake would be reduced 12–21% during the adult striped bass  
40 migration compared to baseline (NAA). Migration conditions for striped bass would be similar  
41 under all flow scenarios for Alternative 4. Sacramento River flows are highly variable inter-annually,

1 but striped bass are still able to migrate upstream the Sacramento River during years of lower flows.  
2 The effect of reduced Sacramento flows under Alternative 4 would not be adverse.

3 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
4 significant because the changes in flow under Scenario H3 (21–27% lower compared to Existing  
5 Conditions) would not interfere substantially with movement of pre-spawning striped bass through  
6 the Delta. Conditions would also be similar under the other flow scenarios for Alternative 4. No  
7 mitigation would be required.

#### 8 **American Shad**

9 **NEPA Effects:** Flows in the Sacramento River below the north Delta diversion facilities under  
10 Scenario H3 would be reduced relative to the NEPA point of comparison (NAA) during March–May.  
11 Monthly flows on average under Scenario H3 would be reduced 14–21% relative to baseline (NAA).  
12 Conditions would be similar between Scenarios H1 and H3, while flows downstream of the north  
13 Delta intakes would be decreased less under Scenarios H4 relative to Scenario H3. Flows from the  
14 San Joaquin River at Vernalis would be unchanged under Alternative 4 flow scenarios. Sacramento  
15 River flows are highly variable inter-annually, and American shad are still able to migrate upstream  
16 the Sacramento River during lower flow years. Overall, the impact to American shad migration  
17 habitat conditions would not be adverse under Alternative 4.

18 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
19 significant because the changes in flow under Scenario H3 (21–27% lower compared to Existing  
20 Conditions) would not interfere substantially with movement of American shad from the Delta to  
21 upstream spawning habitat. Flows would be less reduced under Scenario H4 because of reduced  
22 exports at the north Delta intakes compared to the other flow scenarios. No mitigation would be  
23 required.

#### 24 **Threadfin Shad**

25 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish  
26 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn.  
27 Therefore there is no effect on migration habitat conditions.

28 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than  
29 significant because flow changes in the Delta under Alternative 4 would not alter movement  
30 patterns for threadfin shad. No mitigation would be required.

#### 31 **Largemouth Bass**

32 **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use  
33 the Delta as a migration habitat corridor. There would be no effect.

34 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 4 would not  
35 affect largemouth movements within the Delta. No mitigation would be required.

#### 36 **Sacramento Tule Perch**

37 **NEPA Effects:** Similar with largemouth bass, Sacramento tule perch are a non-migratory species and  
38 do not use the Delta as a migration corridor as they are a resident Delta species. There would be no  
39 effect.

1 **CEQA Conclusion:** As described immediately above, flow changes would not affect Sacramento tule  
2 perch movements within the Delta. No mitigation would be required.

3 **Sacramento-San Joaquin Roach**

4 **NEPA Effects:** For Sacramento-San Joaquin roach, the overall flows and temperature in upstream  
5 rivers during migration to their spawning grounds would be similar to those described under  
6 Alternative 4, Impact AQUA-202 for spawning. As described there, the flows would slightly improve  
7 the upstream conditions relative to the NEPA point of comparison. These conditions would not be  
8 adverse.

9 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
10 conditions for Sacramento-San Joaquin roach would be less than significant and no mitigation would  
11 be required.

12 **Hardhead**

13 **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration  
14 to their spawning grounds would be similar to those described under Alternative 4, Impact AQUA-  
15 202 for spawning. As described there, the flows would slightly improve the upstream conditions  
16 relative to the NEPA point of comparison. These conditions would not be adverse.

17 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration  
18 conditions for hardhead would be less than significant and no mitigation would be required.

19 **California Bay Shrimp**

20 **NEPA Effects:** The effect of water operations on migration conditions of California bay shrimp under  
21 Alternative 4 would be similar to that described for Alternative 1A (see Alternative 1A, Impact  
22 AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects  
23 would not be adverse.

24 **CEQA Conclusion:** As described above the impacts on California bay shrimp rearing habitat would  
25 be less than significant and no mitigation would be required.

26 **Restoration Measures (CM2, CM4–CM7, and CM10)**

27 The effects of restoration measures under Alternative 4 would be similar for all non-covered species;  
28 therefore, the analysis below is combined for all non-covered species instead of analyzed by  
29 individual species.

30 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic  
31 Species of Primary Management Concern**

32 **NEPA Effects:** Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of  
33 construction of restoration measures on non-covered species of primary management concern. The  
34 potential effects of the construction of restoration measures under Alternative 4 would be similar to  
35 those described for Alternative 1A (see Alternative 1A, Impact AQUA-7). For a detailed discussion,  
36 please see Alternative 1A, Impact AQUA-7. The effects would not be adverse.

37 **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration  
38 measures would be less than significant and no mitigation would be required.

1 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**  
2 **Covered Aquatic Species of Primary Management Concern**

3 *NEPA Effects:* Refer to Impact AQUA-8 under delta smelt for a discussion of the effects of  
4 contaminants associated with restoration measures on non-covered species of primary  
5 management concern. The potential effects of the construction of contaminants associated with  
6 restoration measures under Alternative 4 would be similar to those described for Alternative 1A  
7 (see Alternative 1A, Impact AQUA-8). For a detailed discussion, please see Alternative 1A, Impact  
8 AQUA-8. The effects would not be adverse.

9 *CEQA Conclusion:* As described immediately above, the impacts of the contaminants associated with  
10 restoration measures would be less than significant and no mitigation would be required.

11 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**  
12 **Primary Management Concern**

13 *NEPA Effects:* Refer to Impact AQUA-9 under delta smelt for a general discussion of the effects of  
14 restored habitat conditions on non-covered species of primary management concern. Although  
15 there are minor differences the effects are similar. The potential effects of restored habitat  
16 conditions under Alternative 4 would be similar to those described for Alternative 1A (see  
17 Alternative 1A, Impact AQUA-8 and AQUA-9). For a detailed discussion, please see Alternative 1A,  
18 Impact AQUA-8. In addition, see Alternative 1A, Impact AQUA-207 for a discussion of the different  
19 effects on non-covered species of primary management concern. The effects range from slightly  
20 beneficial to beneficial.

21 *CEQA Conclusion:* As described immediately above, the impacts of restored habitat conditions  
22 would range from slightly beneficial to beneficial and no mitigation would be required.

23 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**  
24 **Primary Management Concern (CM12)**

25 *NEPA Effects:* Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of  
26 methylmercury management on non-covered species of primary management concern. The  
27 potential effects of methylmercury management under Alternative 4 would be similar to those  
28 described for Alternative 1A (see Alternative 1A, Impact AQUA-10). For a detailed discussion, please  
29 see Alternative 1A, Impact AQUA-10. The effects would not be adverse.

30 *CEQA Conclusion:* As described immediately above, the impacts of methylmercury management  
31 would be less than significant and no mitigation would be required.

32 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**  
33 **Aquatic Species of Primary Management Concern (CM13)**

34 *NEPA Effects:* Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive  
35 aquatic vegetation management on non-covered species of primary management concern. The  
36 potential effects of invasive aquatic vegetation management under Alternative 4 would be similar to  
37 those described for Alternative 1A (see Alternative 1A, Impact AQUA-11) except for predatory  
38 species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation  
39 provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule  
40 perch also use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun  
41 marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect these

1 predatory species and Sacramento tule perch. However, this control will not substantially reduce the  
2 ability of the predatory species to hunt and there will still be many other habitats in which the  
3 predatory species can successfully hunt and in which Sacramento tule perch will thrive. The effect  
4 on them will not be adverse.

5 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of  
6 invasive aquatic vegetation management on non-covered species of primary management concern.  
7 There are minor differences and the effects are similar except for predatory species (striped bass  
8 and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding  
9 habitat for predatory fish which improves their hunting success. Sacramento tule perch use the  
10 cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently,  
11 reducing the amount of invasive aquatic habitat will negatively affect the predatory species and  
12 Sacramento tule perch. However, this control will not substantially reduce the ability of the  
13 predatory species to hunt and there will still be many other habitats in which the predatory species  
14 can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on them  
15 will not be significant and no mitigation would be required.

#### 16 **Other Conservation Measures (CM12–CM19 and CM21)**

17 The effects of other conservation measure under Alternative 4 would be similar for all non-covered  
18 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by  
19 individual species.

#### 20 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic 21 Species of Primary Management Concern (CM14)**

22 **NEPA Effects:** Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved  
23 oxygen management on non-covered species of primary management concern. The potential effects  
24 of dissolved oxygen management under Alternative 4 would be similar to those described for  
25 Alternative 1A (see Alternative 1A, Impact AQUA-12). For a detailed discussion, please see  
26 Alternative 1A, Impact AQUA-12. These effects would be beneficial.

27 **CEQA Conclusion:** As described immediately above, the impacts of oxygen level management would  
28 be beneficial and no mitigation would be required.

#### 29 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic 30 Species of Primary Management Concern (CM15)**

31 **NEPA Effects:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the  
32 effects of predatory fish (striped bass and largemouth bass) and predator management on non-  
33 predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory  
34 fish and to reduce their hunting success. This management will have negative effects on predatory  
35 fish. However, the numbers of predatory fish are high and the extent of the habitats in which they  
36 hunt is extensive. Therefore the effects of this management will not be adverse.

37 **CEQA Conclusion:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the  
38 effects of predatory fish and predator management on non-predatory fish. The purpose of predatory  
39 fish management is to reduce the numbers of predatory fish and to reduce their hunting success.  
40 This management will have negative effects on predatory fish. However, the numbers of predatory

1 fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of  
2 this management will not be significant. No mitigation is required.

3 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**  
4 **Primary Management Concern (CM16)**

5 *NEPA Effects:* Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of  
6 nonphysical fish barriers on non-covered species of primary management concern. The potential  
7 effects of nonphysical fish barriers under Alternative 4 would be similar to those described for  
8 Alternative 1A (see Alternative 1A, Impact AQUA-14). For a detailed discussion, please see  
9 Alternative 1A, Impact AQUA-14. The effects would be similar except for Sacramento-San Joaquin  
10 roach and hardhead which are unlikely to be present in their vicinity. California bay shrimp do not  
11 occur in these habitats and there would be no effect on them. The effects would not be adverse.

12 *CEQA Conclusion:* As described immediately above, the impacts of nonphysical fish barriers would  
13 be less than significant and no mitigation would be required.

14 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**  
15 **Primary Management Concern (CM17)**

16 *NEPA Effects:* Refer to Impact AQUA-15 under delta smelt for a discussion of the effects of illegal  
17 harvest reduction on non-covered species of primary management concern. The potential effects of  
18 illegal harvest reduction under Alternative 4 would be similar to those described for Alternative 1A  
19 (see Alternative 1A, Impact AQUA-15). For a detailed discussion, please see Alternative 1A, Impact  
20 AQUA-15. The effects would not be adverse.

21 *CEQA Conclusion:* As described immediately above, the impacts of illegal harvest reduction would  
22 be less than significant and no mitigation would be required.

23 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**  
24 **Primary Management Concern (CM18)**

25 *NEPA Effects:* Refer to Impact AQUA-16 under delta smelt for a discussion of the effects of  
26 conservation hatcheries on non-covered species of primary management concern. The potential  
27 effects of conservation hatcheries under Alternative 4 would be similar to those described for  
28 Alternative 1A (see Alternative 1A, Impact AQUA-16). For a detailed discussion, please see  
29 Alternative 1A, Impact AQUA-16. There would be no effect.

30 *CEQA Conclusion:* As described immediately above, conservation hatcheries would have no impact  
31 and no mitigation would be required.

32 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**  
33 **of Primary Management Concern (CM19)**

34 *NEPA Effects:* Refer to Impact AQUA-17 under delta smelt for a discussion of the effects of  
35 stormwater treatment on non-covered species of primary management concern. The potential  
36 effects of stormwater treatment under Alternative 4 would be similar to those described for  
37 Alternative 1A (see Alternative 1A, Impact AQUA-17). For a detailed discussion, please see  
38 Alternative 1A, Impact AQUA-17. The effects would be beneficial.

1 **CEQA Conclusion:** As described immediately above, the impacts of stormwater management would  
2 be beneficial and no mitigation would be required.

3 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**  
4 **Aquatic Species of Primary Management Concern (CM21)**

5 **NEPA Effects:** Refer to Impact AQUA-18 under delta smelt for a discussion of the effects of  
6 removal/relocation of nonproject diversions on non-covered species of primary management  
7 concern. The potential effects of removal/relocation of nonproject diversions under Alternative 4  
8 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-18). For a  
9 detailed discussion, please see Alternative 1A, Impact AQUA-18. The effects would be similar except  
10 for Sacramento-San Joaquin roach, hardhead and Sacramento tule perch which are unlikely to be  
11 present near these diversions. The effects would not be adverse.

12 **CEQA Conclusion:** As described immediately above, the impacts of removal/relocation of nonproject  
13 diversions would be less than significant and no mitigation would be required.

14 **Upstream Reservoirs**

15 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

16 **NEPA Effects:** Similar to the description for Alternative 1A, this effect would not be adverse because  
17 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 4 would not be  
18 substantially reduced when compared to the No Action Alternative.

19 **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 4 would reduce the  
20 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be  
21 a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant  
22 impact. These results are primarily caused by four factors: differences in sea level rise, differences in  
23 climate change, future water demands, and implementation of the alternative. The analysis  
24 described above comparing Existing Conditions to Alternative 4 does not partition the effect of  
25 implementation of the alternative from those of sea level rise, climate change and future water  
26 demands using the model simulation results presented in this chapter. However, the increment of  
27 change attributable to the alternative is well informed by the results from the NEPA analysis, which  
28 found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 4, if  
29 adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and  
30 therefore would not in itself result in a significant impact on coldwater habitat in upstream  
31 reservoirs. This impact is found to be less than significant and no mitigation is required.